First-day road log: West flank of Florida Mountains

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FIRST-DAY ROAD LOG, WEST FLANK OF FLORIDA MOUNTAINS

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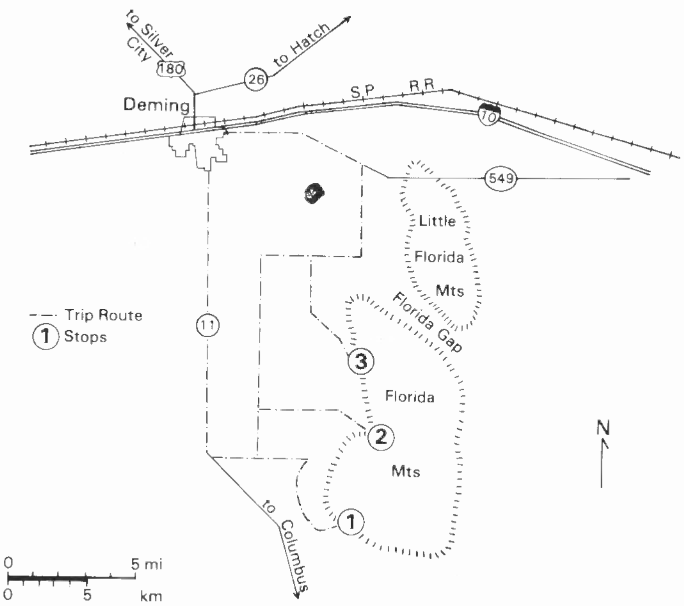
THURSDAY, OCTOBER 6, 1988

Assembly point: Luna Cotton Co-op gin, west side of NM-11, 1.6 mi south of Pine Street in Deming.
Departure time: 7:30 a.m.
Distance: 64.7 mi
Stops: 3



SUMMARY

The first-day tour will visit the southwestern end and western flank of the Florida Mountains. The route proceeds southward in the Mimbres basin for about 11 mi before turning east to the mountains, through the Nathan Crawford Ranch. This access route is available by special permission of Nathan Crawford only for this conference. Please drive only on the road followed by the caravan and do not litter.

Stop 1 provides an introduction to the geology of the Florida Mountains (Fig. 1:4.5a, b) and an opportunity to view and sample the Upper Cambrian (503 my) interlayered granite and hornfels that compose the southern end of the Florida Mountains. This stop will include a short hike up the canyon to see well exposed xenoliths (autoliths?) of the hornfels. The tour will backtrack to a section-line road west of the Crawford Ranch and then turn north and parallel the mountain front for two miles before turning east again.

Stop 2 in Mahoney Park is near the south Florida Mountain fault (SFMF) zone. This zone includes a high-angle reverse fault, with probable right-lateral displacement, and several small thrust faults. The SFMF has placed Upper Cambrian granite of the uplifted south block against Upper Cambrian syenite and Paleozoic sedimentary strata of the north block. This stop will include a fairly strenuous hike to observe thrust-faulted Montoya-Fusselman strata, the SFMF, granite and syenite. From Stop 2 the tour travels back west to section-line road and then north before turning east again to Capitol Dome. Stop 3 will be on the south side of Capitol Dome. Upper Cambrian granite and syenite, deformed lower Paleozoic rocks and undeformed lower to middle Tertiary Lobo and Rubio Peak Formations are well exposed in this area. The tour ends for the day here and returns to Deming, passing over the west Florida Mountains fault several times, the deepest part of the Mimbres basin and near the sites of three Seville-Trident exploration wells.

Mileage

0.0 Luna Cotton Co-op gin. **1.5**

1.5 Junction with NM-497. **Continue straight.** Red Mtn, a rhyolite dome, at 3:00. **1.0**

2.5 Junction; O'Kelley Road, **continue straight. 1.0**

3.5 Junction; paved road on left goes to Rockhound and Spring Canyon State Parks. At 9:00 are the Little Florida Mtns. **1.0**

4.5 Junction with NM-490 on right, **continue straight.** From 9:00 to 10:00 on the skyline are jagged spires formed by erosion of Eocene Rubio Peak volcanic breccia at the northern end of the Florida Mtns (Fig. 1:4.5c). The highest spire at 10:00 is Florida Peak (2271 m).

Dragon Ridge at 9:00 is composed of east-dipping Rubio Peak volcanic breccias. The lower, rounded knob at 9:30 near the base of the volcanics is Capitol Dome (1818 m). Underlying the northeast-dipping volcanic

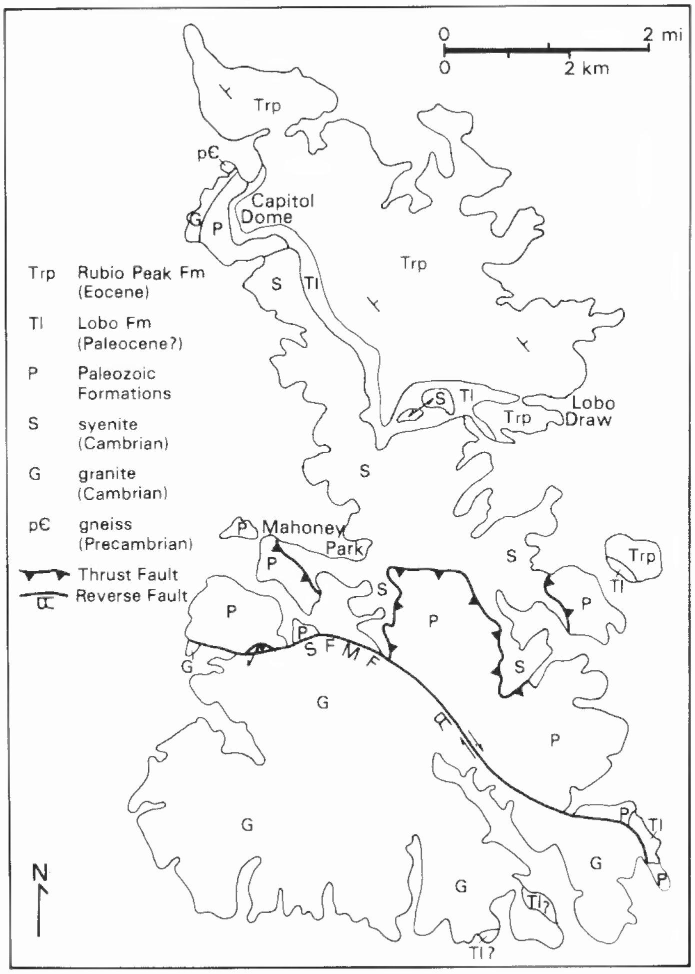


FIGURE 1:4.5a. Generalized geologic map of the Florida Mtns.

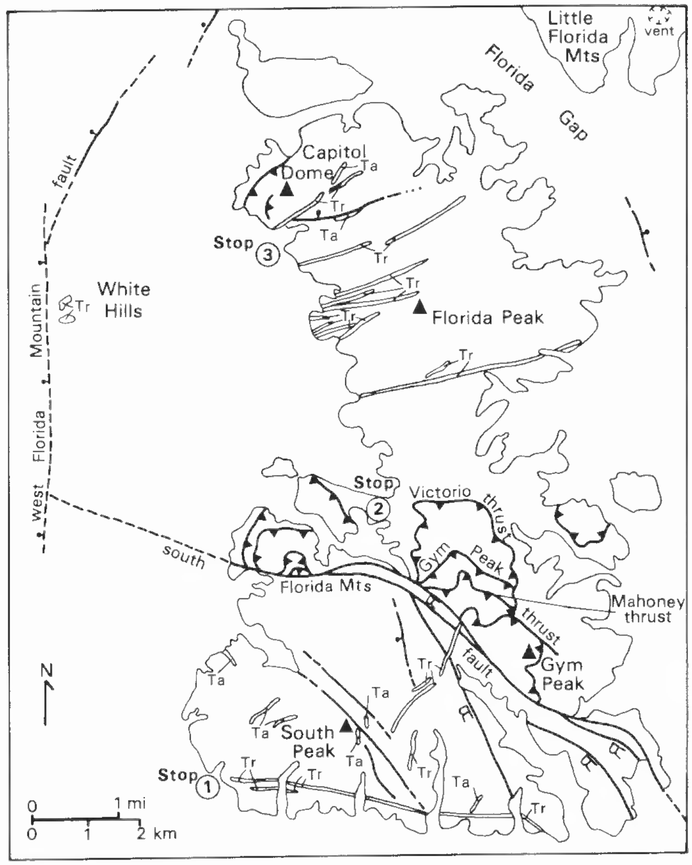


FIGURE 1:4.5b. Tectonic map of the Florida Mtns and southeastern end of the Little Florida Mtns, showing locations of three stops.

unit are Paleocene-Eocene(?) Lobo Fm red beds forming a less resistant slope unit. The ledges below are lower Paleozoic sedimentary rocks that unconformably underlie the red beds. At the base of the exposed section are knobs of Upper Cambrian granite and Precambrian metamorphic rocks.

At 11:30 are the triple peaks of the Tres Hermanas Mtns (1769 m). At 12:30 is Sierra Alta (2302 m) in Mexico, an uplifted fault block of upper Paleozoic rocks. From 1:30 to 2:30 is the Cedar Mtn Range (1895 m) composed of Tertiary volcanic rocks. At 2:00 on the skyline, Big Hatchet Peak (2551 m) is barely visible. At 2:30 are the Klondike Hills (1606 m), composed mainly of thrust-faulted lower Paleozoic rocks. **3.0**

7.5 Junction with NM-332, **continue straight.** Sunshine School on right. **2.1**

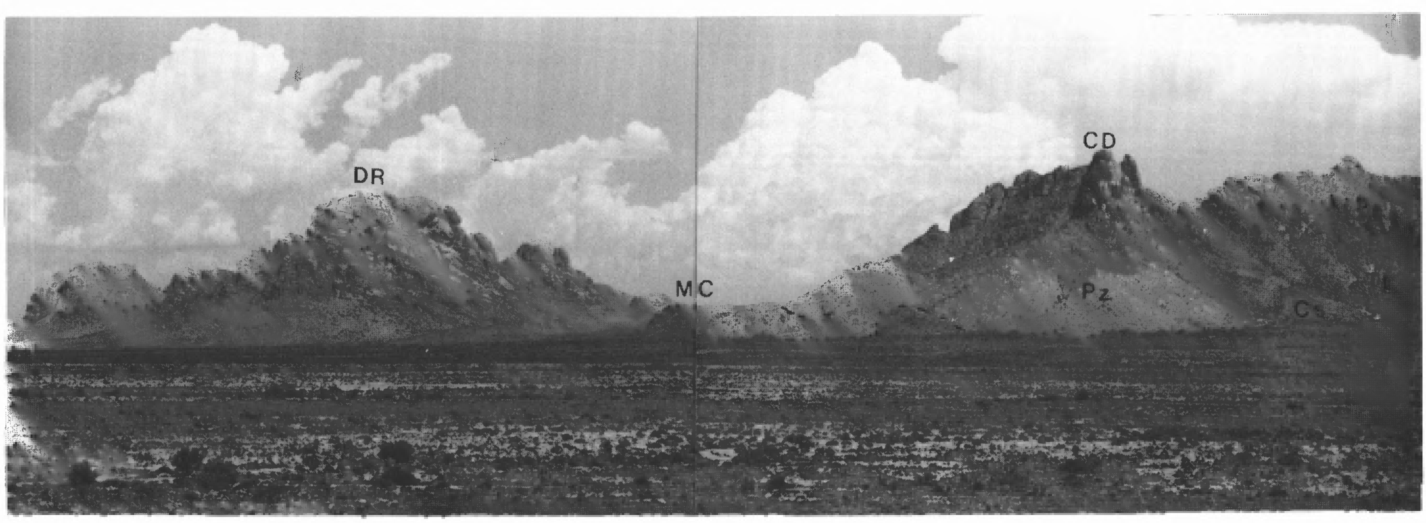


FIGURE 1:4.5c. Panorama of northwest side of Florida Mtns (DR: Dragon Ridge, CD: Capitol Dome, FP: Florida Peak,

EARTH FISSURES IN THE DEMING AREA

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Earth fissures are long, narrow, eroded tension cracks. They have been described in numerous areas of the southwestern United States including but not limited to: the Fremont, San Jacinto and San Joaquin Valleys of California (Holzer, 1984), Las Vegas, Nevada (Mindling, 1971), and central and southern Arizona (Schumann and Poland, 1970; Holzer, 1984; Larson and Péwé, 1986). Earth fissures in these areas typically develop in basin-fill alluvium, primarily as a manifestation of ground-water depletion and associated land subsidence. Twelve discrete areas of fissure formation have also been identified in the Mimbres Basin near Deming (Fig. 1:7.5a).

The basin-fill alluvium of the Mimbres Basin has a maximum thickness of approximately 1200 m (Clemons, 1986a; Seager, in press). Its lower unit consists of alluvial-fan and playa deposits which are middle Pleistocene and older. The upper unit is composed of admixtures of gravel, sand, silt and clay, and represents fan-delta or splay sedimentation by the Mimbres River during the late Quaternary (J. W. Hawley, written commun. 1988).

The sand and gravel deposits in the basin-fill alluvium are the major aquifer in the Mimbres Basin. Generally unconfined, the aquifer is recharged by seepage from the Mimbres River and San Vicente Arroyo and, to a lesser extent, by runoff from the Florida Mountains (White, 1929; Doty, 1959). Withdrawals of ground water for irrigation began in 1908, and the demand since then for irrigation and other purposes has increased steadily. The maximum water-level decline in the Deming area from 1910 to 1983 was slightly greater than 33 m (Fig. 1:7.5b). Conspicuous is an elliptical cone of depression elongated north-south and centered about 13 km south-southwest of Deming.

Earth fissures in the Deming area have two types of patterns: (1) orthogonal to polygonal and (2) curvilinear. An orthogonal to polygonal pattern consists of a series of fissures interconnected to form triple junctions. Individual polygons range from 30 to 366 m across. Curvilinear fissures are arcuate and exist isolated from each other within seven of their eight areas of occurrence. Most curvilinear fissures trend north-south; their lengths range from 30 to 640 m.

Fissures first appear at the surface as a series of aligned depressions or holes, or as hairline cracks. Infiltration and erosion enlarge the fissures and cause the roofs of soil tunnels to collapse, fully exposing the fissures at the surface (Fig. 1:7.5c). Surface runoff promotes enlargement of the fissures by slumping of the fissure walls and by tributary gullying. Piping tunnels that extend downward into the fissures are conduits through which surface material is carried into the subsurface. As a result, large topographic features can be developed on relatively

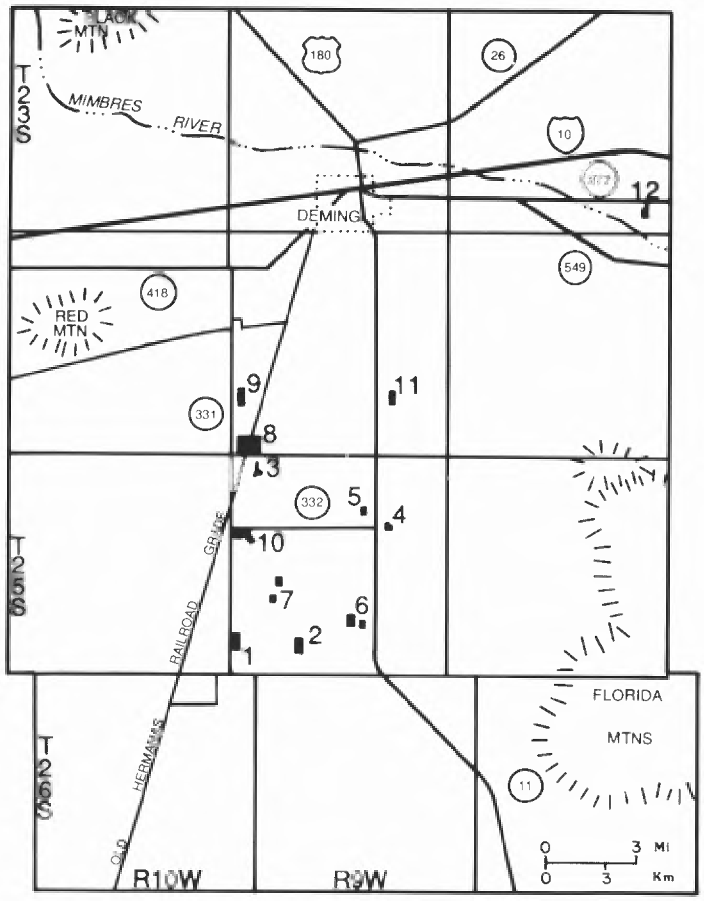
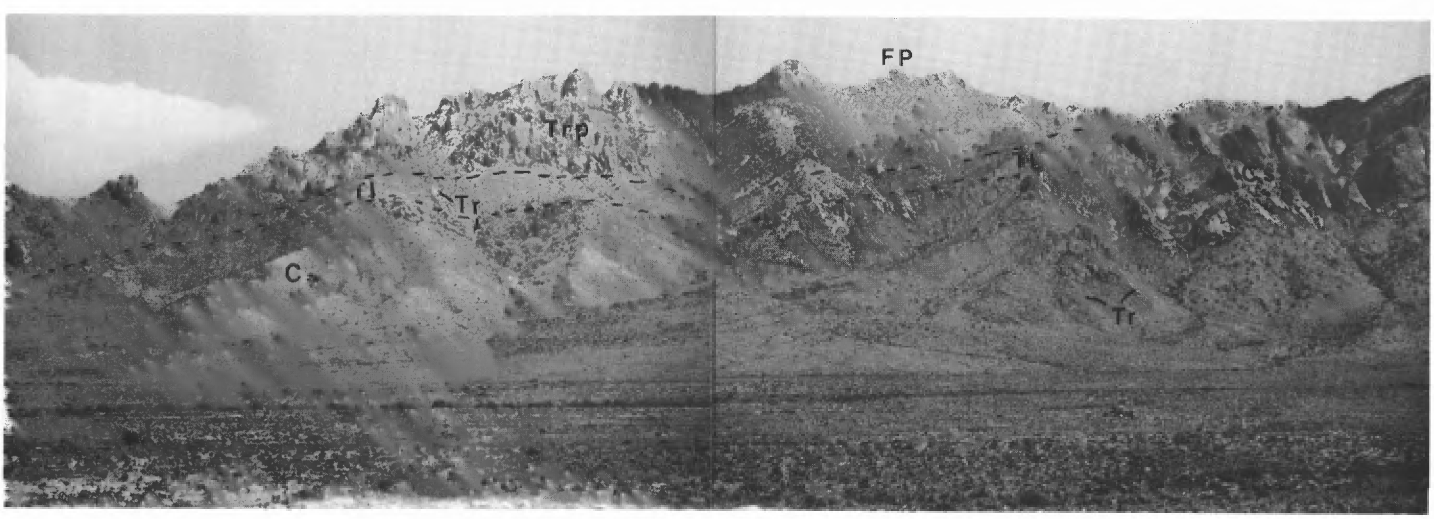


FIGURE 1:7.5a. Location of earth fissures in the Deming area.

flat land (Fig. 1:7.5d). The widest earth fissure observed near Deming is 10 m, the deepest 13 m. Depth values are conservative and represent the limit to which a weighted tape can be lowered into the narrowest zones of the fissures.

Problems related to the Deming earth fissures include: damage to roads, water wells and stock tanks, abandonment of irrigated land, and various safety hazards. Sixteen instances of road damage have been documented. Much of the soil material used to patch the fissured roads is eventually lost through piping processes, making road repair not only costly but continuous. Cattle have reportedly fallen into earth fissures,



MC: Mexican Canyon, Trp: Rubio Peak Fm, Cg: granite, Pz: lower Paleozoic, Tl: Lobo Fm, Cs: syenite, Tr: rhyolite dike).

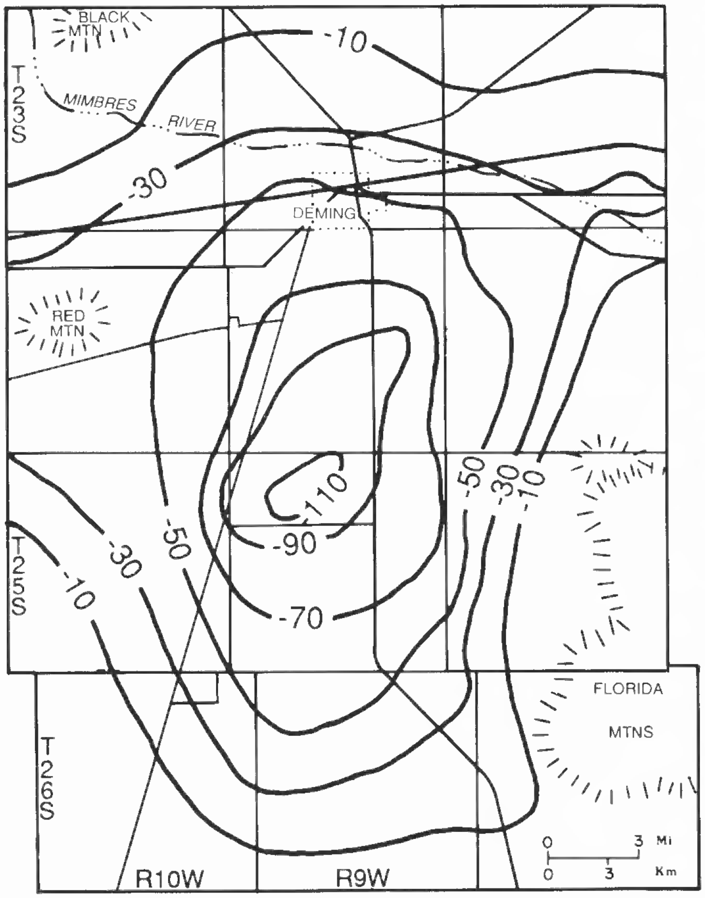


FIGURE 1:7.5b. Total water-level decline in the Deming area from 1910 to 1983. Contours are in feet.

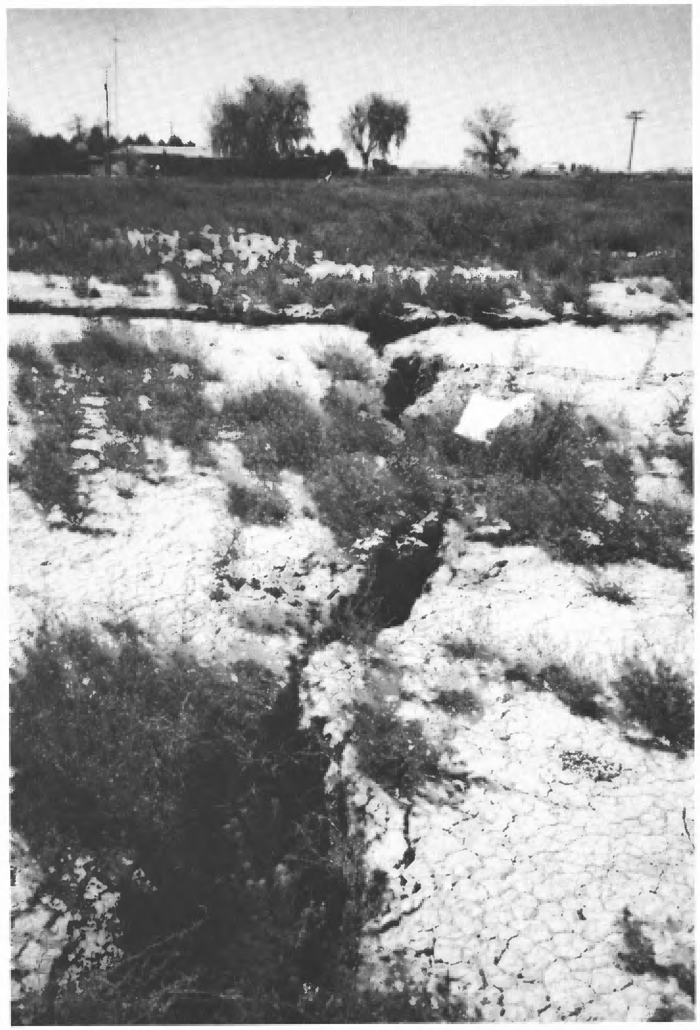


FIGURE 1:7.5c. Intersection of two curvilinear fissures at earth fissure location 1. The fissures developed in subdivided rangeland in June 1982. View is northwest.

and the hazard to off-road vehicles and passengers is equally great. The use of earth fissures as waste disposal sites poses a serious threat of ground-water contamination.

The spatial and temporal association of water-level decline with earth fissure formation in the Mimbres Basin suggests a cause and effect relationship. As greater demands are placed on the aquifer, additional earth fissure propagation can be expected. Further structural problems are anticipated in the Deming area and may include damage to aqueducts, water lines, storm drains, sewer mains, gas mains and buildings. Current studies of earth fissures in New Mexico and elsewhere may help mitigate existing and potential problems.

9.6 MP24 (from Palomas, Mexico). **0.9**

10.5 Elote Road to right, **continue straight. 0.1**

10.6 MP23. **0.4**

11.0 Highway curves left; NM-517 to right at southeast end of curve. **Slow, prepare for left turn. 0.5**

11.5 **Turn left,** cross cattleguard and proceed east on gravel road. Baldy Peak (2122 m) on skyline at 11:30 is El Paso limestone resting in thrust-fault contact on Upper Cambrian syenite. South Peak (2160 m) at 1:00 is Upper Cambrian granite and hornfels. Small conical hill at 2:00 near the toe of the bajada is a late Tertiary basalt plug(?). Tres Hermanas Mtns at 3:00 are underlain by 40 my old quartz monzonite, which intruded and metamorphosed Mississippian to Permian carbonate rocks. Rhyolite and latite flows, breccias and tuffs form some of the foothills. The westernmost part of the Tres Hermanas are called the West Lime Hills. Prospect pits are found all over the mountains, but the main mines are on the northwest side. Operations were fairly continuous from 1905 to 1920, and have been sporadic since that time. While zinc and lead were the most important metals produced, significant amounts of silver, gold and copper have also been mined. **1.4**

12.9 Dirt road on right, **continue straight. 0.3**

13.2 Gravel road on left, **continue straight. 0.2**

13.4 Cattleguard. Road crosses covered west Florida Mtns fault about 0.5 mi ahead. Some earlier reports placed the fault another 1.5 mi to the east due to confusion of where an "Angelus No. 2" well is located (Clemons, in press). **1.5**

14.9 Open fence gate. Ridge at 12:00 (Fig. 1:14.9) is composed of thrust-faulted, east-dipping Fusselman Dol to be visited at Stop 2. South Florida Mtns fault goes through small saddle at 1:00. Upper Cambrian granite south of fault. **0.3**

15.2 Nathan Crawford Ranch. Proceed slowly and **turn sharp right** onto private ranch road. **0.7**

15.9 Fence gate. Note layering of granite and hornfels-rich

FIGURE 1:7.5d. This curvilinear fissure developed in rangeland in 1982 and extended itself in Oct. 1984. It developed in a topographic low and widened rapidly as surface runoff and sediment were piped downward.

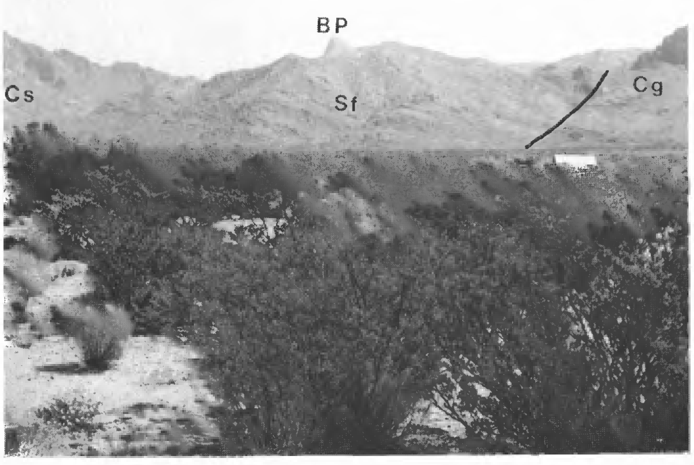


FIGURE 1:14.9. View eastward of ridge on south side of Mahoney Park (BP: Baldy Peak, Cs: syenite, Cg: granite, Sf: Fusselman Dol). Crawford ranch house in right middleground.

FIGURE 1:15.9. View eastward of South Peak (SP) and layered granite and hornfels dipping about 30 degrees.

zones at 10:00 (Fig. 1:15.9). Generally granite forms cliffs and ledges; hornfels weathers more readily to form the intervening slopes. Unnamed peak (2166 m) is composed of granite without hornfels. **1.2**

17.1 Water storage tank, **turn sharp left,** then right. South Peak at 12:00. **0.8**

17.9 Water tank on left. Tres Hermanas Mtns at 1:30; West Lime Hills are low ridge at 2:30 in front of Sierra Alta (far distance).

Upper Paleozoic and Lower Cretaceous rocks of varying thicknesses must underlie much of southeastern Luna County. Outcrops in the northeastern Tres Hermanas Mtns (Kottlowski and Foster, 1962) contain Mississippian (110 m), Pennsylvanian (170 m) and Permian (160 m) rocks. The Permian section may be much thicker, because what was mapped as Fusselman Dol (Balk, 1962) is probably Epitaph Dol. Supporting evidence for this interpretation is present about four km to the west in the West Lime Hills. We have reexamined the section published by Kottlowski and Foster (1962), and have studied thin sections from this section in two 700 m cores (courtesy of Ben Donegan & Leonard Minerals Co.) 1.2 and 3.2 km north of West Lime Hills and from two small outliers 4.5 and 5.6 km northwest of West Lime Hills. The northernmost exposure is Hueco or Colina Ls, and the small hill 1.1 km to the southeast of that exposure is composed probably of Colina Ls overlain by Epitaph Dol. One of the cores between this hill and the West Lime Hills contains about 457 m of fossiliferous, black limestone and shale probably belonging to the Colina. The basal 113 m of the West Lime Hills section is now interpreted to be correlative with the Hell-to-Finish Fm (Lower Cretaceous). The top of the Hell-to-Finish section is in fault contact with about 122 m of massive marbleized limestones, which are probably of Permian age. These are overlain by, or in fault contact with, about 122 m of conglomerates that are probably correlative with the Paleocene-Eocene(?) Lobo Fm. About 100 m of limestone and dolomite that cap the long ridge of the West Lime Hills have been thrust onto the Lobo conglomerates. A. C. Selby and T. R. Carr of ARCO Exploration Company collected samples during the 1981

El Paso Geological Society field trip and identified early Leonardian conodonts from the dolomites (Thompson, 1982). Some of the limestones contain solitary corals and large gastropods similar to those typical of the Colina-Hueco Fms. Therefore the carbonates composing the small thrust plate are considered correlative with the Colina-Epitaph Fms. **0.3**

18.2 Water tank on left. **0.7**

18.9 **STOP 1.** End of road near mouth of unnamed canyon. The plutonic rocks in the Florida Mtns were originally mapped by Darton (1916, 1917) as Precambrian granite, and later as three kinds of granite and a diorite by Griswold (1961). Corbitt (1971) mapped and described the plutonic rocks as Precambrian granite and Mesozoic syenite intruded by gabbro and anorthosite. Corbitt (1974) later noted the possibility that the syenite, gabbro and anorthosite were actually Precambrian with partially reset isotopic systems. Brookins (1974a, b, 1980a, b; Brookins and Corbitt, 1974) began Rb-Sr isotopic studies of plutonic rocks in the Florida Mtns simultaneously with Corbitt's work. Rb-Sr ages of 456 ± 8 to 515 ± 26 my on feldspar and 500 to 750 my on whole rock samples of quartz syenite from the northern Florida Mountains were reported by Brookins (1974b) and Brookins and Corbitt (1974). K-Ar dates of hornblende from quartz syenite and hornblende gabbro range from 418 ± 8 to 555 ± 11 my (Brookins, 1974b). Whole rock Rb-Sr isochrons of $1{,}600 \pm 150$ my for a quartz monzonite-granodiorite suite, 395 ± 27 my for syenite and 371 ± 19 my for quartz syenite were published by Brookins (1980b). Matheny and Brookins (1983) reported a 35-point whole rock Rb-Sr isochron of 420 ± 20 my for samples of syenite, alkali granite and gabbro.

Despite the imprecision of the Rb-Sr data and the variety of interpretations possible for the K-Ar results, the work has provided an intriguing hint of lower or middle Paleozoic plutonism in the Florida Mtns. Evans and Clemons (1988) attempted to resolve the apparent age enigma by application of U-Th-Pb dating of cogenetic zircon suites from various plutonic units of the range following mapping of the mountains by Clemons (1982b, c, 1984, 1985, 1986b) and Clemons and Brown (1983).

Hornfelsic intermediate to mafic igneous rocks occur as inclusions (Fig. 1:18.9a) in the alkalic igneous bodies. The hornfels typically average 48% intermediate plagioclase and 33% hornblende with minor biotite, pyroxene, alteration products and accessory apatite, sphene(?), magnetite and zircon. Plagioclase is extensively altered to clay minerals and sericite, although locally samples contain fresh plagioclase (sodic labradorite) and abundant hypersthene and olivine.

Hornfels is most abundant in the southern Florida Mtns where it occurs as ovoid blobs or elongate slabs up to 15 m in length in the alkali-feldspar granite. Some inclusions have rims which are finer grained than the cores, and many have crenulite margins. These layered zones of hornfels inclusions dip 25 to 35 degrees northeast (Figs. 1:15.9 and 1:18.9b) near South Peak. The origin of the hornfels inclusions are either xenoliths of intermediate to mafic volanic rocks which were completely recrystallized and stoped into the alkalic magma, or a mafic comagmatic portion of the plutonic complex in the Florida Mtns (Evans and Clemons, 1988). The alkali-feldspar granite is coarse-grained and light to medium gray where inclusions are lacking, whereas it is fine to medium grained and reddish where inclusions are abundant. The two types of alkali-feldspar granite are mineralogically indistinguishable in thin section. The average alkali-feldspar granite contains 65% perthite and microcline, 27% quartz, 2% hornblende and 6% chlorite (altered hornblende and hastingsite), magnetite, zircon, sphene and apatite.

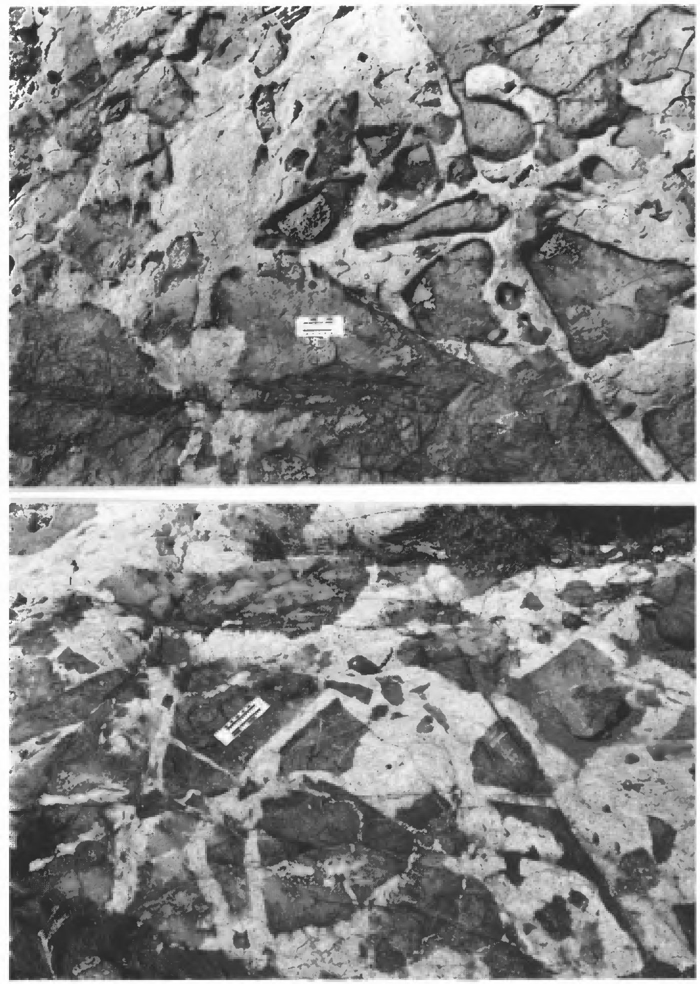


FIGURE 1:18.9a. Hornfels xenoliths (or autoliths?) in granite at Stop 1.

U-Pb ages determined on zircon separates from the hornfels and enclosing granite are 504 ± 10 my and 503 ± 10 my respectively (Evans and Clemons, 1988). A Pb 207/206 age of 503 my was also determined for the granite zircons. Identical ages of the granite and hornfels indicates the hornfels are either completely recrystallized zenoliths of basement andesites and basalt or comagmatic autoliths.

Retrace route to Crawford Ranch. **3.7**

22.6 Ranch house on right; **turn sharp left. 0.4**

23.0 Klondike Hills at 11:30, Victorio Mtns at 1:00, Snake Hills at 1:30, Red Mtn at 2:00, Black Mtn at 2:30. Geology of the Klondike Hills is very similar to that in the southern Florida Mtns except with far less relief and

FIGURE 1:18.9b. View northward from Stop 1 showing hornfels (h) layering in granite.

consequently greater difficulty in interpreting the third dimension (Rupert, 1986). **1.5**

24.5 Cattleguard. **Slow** for right turn ahead. **0.1**

24.6 **Turn right** (north) on gravel road and cross cattleguard. **2.0**

26.6 Crossroad, **turn right** (east). Dragon Ridge at 10:00; Capitol Dome (site of Stop 3) at 11:00; Florida Peak, composed of altered Rubio Peak volcaniclastic rocks, at 11:30; Mahoney Park, site of Stop 2, at 1:00; South Peak at 2:00. About five white rhyolite dikes cut Upper Cambrian syenite (Fig. 1:26.6) and overlying rocks from 11:15 to 12:00. **1.1**

27.7 Road crosses approximate location of covered west Florida Mtns fault. Scarp is clearly visible on aerial photographs to the north but is buried here by eolian deposits. **0.4**

28.1 Road to left goes over White Hills, low rounded hills at 9:00, which are a rhyolite plug or small stock of same composition as dikes cutting the mountain ahead. Feldspar concentrate yielded a K-Ar age of 29.1 my (Clemons, in press). **0.5**

28.6 Junction, **bear right.** Baldy Peak at 12:00 is massive El Paso limestone. Rugged brown cliffs from 10:00 to 12:00 are Upper Cambrian syenite. Zircon concentrates from the syenite studied by C. E. Hedge and L. B.

FIGURE 1:26.6. Rugged cliffs of syenite (ibex country) north of Mahoney Park. Rhyolite dike (Tr) intrudes syenite and overlying Lobo and Rubio Peak Fms.

Fischer with the USGS in Denver, yielded a Pb 207/206 age of 523 my and U/Pb ages of 460 and 471 my (Evans and Clemons, 1987, 1988). The syenite was unroofed before the Bliss Ss was deposited in Late Cambrian or Early Ordovician time (Clemons, in press). **1.0**

29.6 Pass under power line. Well developed, old alluvial fan from 9:00 to 10:00. Pedogenic calcite horizon near surface indicates this fan is probably correlative with Camp Rice Fm. **0.9**

30.5 Fence gate, entering private lands. **0.3**

30.8 Small hill on right with prospect dump is composed of faulted, northeast-dipping lower Fusselman Dol. Cutter limestone and dolomite underlies the Fusselman at far southwest end of the hill (Clemons, 1985). Larger hill at 1:00 contains El Paso (Padre Mbr) in lower slope. It is overlain by Montoya Fm, and lower Fusselman forms crest of hill. Rugged brown cliffs in background at 2:00 are Upper Cambrian granite, south of the south Florida Mtns fault. Grassy slopes with small cedar trees on crest at 10:00 are Paleocene-Eocene(?) Lobo Fm resting on Upper Cambrian syenite. **0.2**

31.0 Large hill at 3:00 composed of highly faulted Fusselman Dol. **0.4**

31.4 Abandoned rock house on left. Small thrust fault in slope to right roughly parallels road. Fault separates El Paso, Montoya and Fusselman Fm (above) from syenite in lower slopes. **0.4**

31.8 Well exposed syenite across arroyo to left is freshest exposed syenite in Florida Mtns. **0.5**

32.3 **STOP 2.** Park (Hilltop) mine on right, parking area on left. The Park (Hilltop) mine is located along the thrust fault that placed Fusselman Dol against Cambrian syenite (Fig. 1:32.3a) Griswold (1961) reported that A. J. Malin staked the Hilltop claim over the deposit in 1958, but most of the development had been done many years before. Northwest-trending, thoroughly oxidized, limonite-rich veins in Fusselman Dol contained dry-bone smithsonite and minor cerussite. No production records are available, but the small dump indicates total production was not more than a few tons. Griswold reported that a grab sample of hand-sorted ore, "not to be considered as representative of ore in place," assayed 26.4%

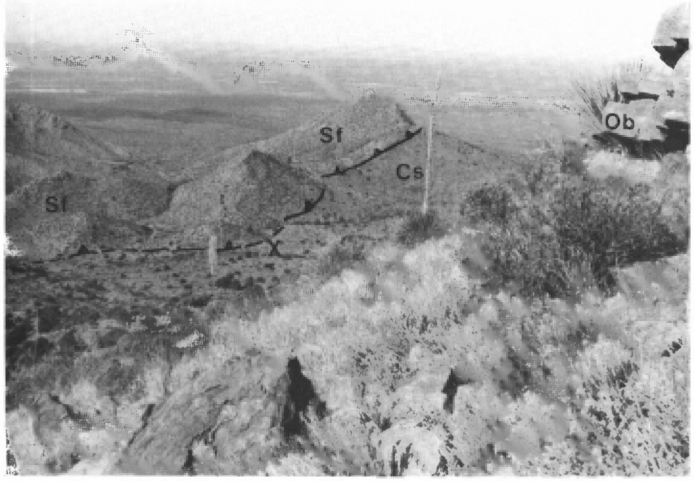


FIGURE 1:32.3a. View westward of Stop 2 (X) in Mahoney Park. Fusselman Dol (Sf) is thrust northeastward over Upper Cambrian syenite (Cs). Slope in foreground is syenite nonconformably overlain by Bliss Ss (Ob).

zinc and a trace of lead. Many small prospect pits in the Fusselman hills south of Mahoney Park were evacuated along thin, irregular veins. Small amounts of galena can be seen on a couple of dumps.

The most prominent structural feature in Mahoney Park is the south Florida Mtns reverse fault (SFMF) that may have right-lateral displacement (Fig. 1:32.3b). Darton (1917) described this fault as a thrust dipping 40–70° south and displacing granite upon the upper beds of his Gym Limestone. Corbitt (1971, 1974) noted that this northwest-trending, steeply dipping, reverse fault is steep at deep structural levels but flattens abruptly upward (Fig. 1:32.3c). This appears to be true in Mahoney Park, but close scrutiny of the fault zone indicates that this is more likely an illusion.

Although the main fault is difficult to locate precisely in the massive, brecciated granite, it probably maintains a N80°W strike through this area, with southerly dips of 65–80°. The apparent flattening of 18° between the granite and the Fusselman is actually a small subsidiary

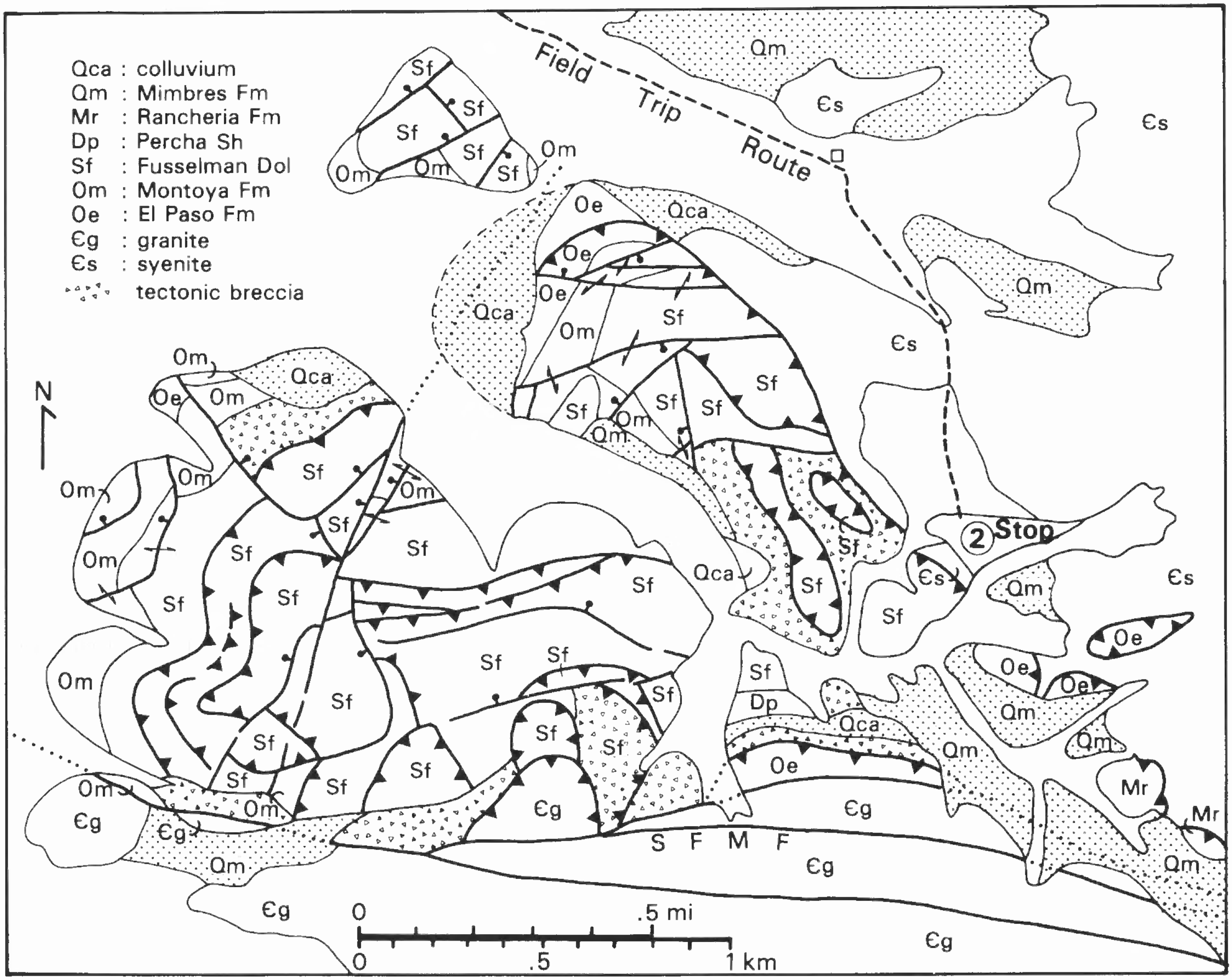


FIGURE 1:32.3b. Generalized geologic map of Mahoney Park (modified from Clemons, 1985, and in press).

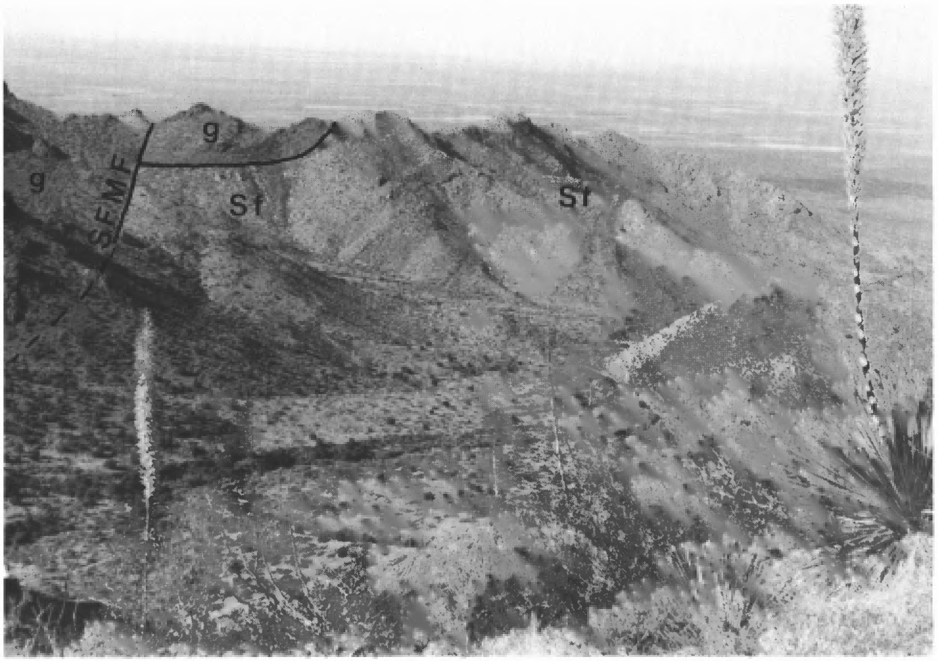


FIGURE 1:32.3c. View westward of Mahoney Park showing SFMF and small thrust plate of granite (g) over Fusselman Dol (Sf).

thrust plate. This is instantly seen, and is a much more striking feature than the thoroughly brecciated granite in the slopes to the south and southeast. After removal of Basin and Range northeast tilting of about 20–25°, the SFMF strikes N50°W and is close to vertical.

The SFMF places Upper Cambrian alkali-feldspar granite against various Paleozoic formations and Upper Cambrian quartz alkakli-feldspar syenite. Several other secondary reverse(?) faults that probably resulted in imbrication are located southwest of the main fault within Cambrian granite. Amount of displacement on these faults is unknown. Clemons and Brown (1983) assigned the thickness of the Paleozoic section (1250 m) as a minimum stratigraphic separation on the SFMF. W. R. Seager (oral commun. 1982) pointed out that some field relations indicate that there may have been significant right-lateral movement on the SFMF. Lower Paleozoic beds east and south of Gym Peak (Clemons and Brown, 1983) show a continuous change in strike from nearly due north, 3.2 km northeast of the fault, to due east adjacent to the fault. A similar relationship in bedding attitudes in Mahoney Park suggests that the change in strike may have been caused by drag as the north block moved eastward relative to the south block. Petrographic study of about 250 thin sections as well as ages suggests that the Cambrian syenite and quartz syenite north (down) of the fault and granite (up) of the fault are consanguinous. Both syenites and granites contain abundant hornfels xenoliths. The overall relation is more easily explained by lateral movement on the fault than by only vertical uplifting that juxtaposed the granite with syenite of the same pluton.

The SFMF cuts rocks as young as Paleocene-Eocene(?) Lobo Fm in the southeast Florida Mtns south of the fault. A small outcrop of Lobo Fm or Rubio Peak Fm rests conformably on the upthrown Cambrian granite block. Numerous small thrust faults that formed penecontemporaneously with the SFMF displace Cambrian and lower Paleozoic rocks south of Mahoney Park. Most of these faults involve intensely deformed, locally brecciated, complex sheets that placed younger strata over older rocks, but locally older rocks were placed over younger rocks. Large slabs of Cutter limestone-dolostone lie within thrust-faulted Fusselman Dol in the SE 1/4, sec. 34, T25S, R8W. Many of the thrust faults can only be mapped with confidence by using a map scale large enough to plot offsets of the six Fusselman Dol units. Several of the thrust faults were probably once continuous with the Victorio, Gym Peak and Mahoney thrusts mapped to the east by Brown (1982) and Clemons and Brown (1983). Brown mapped Gym Peak and Mahoney thrusts under klippen of Rancheria and El Paso rocks near the intersection of sec. 35, T25S, R8W and sec. 2, T26S, R8W. This is probably the same thrust that continues northwestward as the northernmost fault exposed in Mahoney Park at the Hilltop mine.

A small outcrop in the N1/2 SE1/4 SE1/4, sec. 35, T25S, R8W contains three oncolite beds (Fig. 1:32.3d) interbedded with conglomerates. The base of the section is covered in a small gully, and the top is in fault contact with probable El Paso Fm. Its position in the fault zone with nearby Cambrian- to Mississippian-age rocks further hinders placing it in its proper stratigraphic position. The oncolites closely resemble large oncolites at the base of the El Paso Fm in Chaney Canyon at the north end of the Big Hatchet Mtns. The oncolite rims on the angular clasts also resemble oncolites in the upper Abo(?) just below Sarten Ss north of Cooke's Peak. The oncolite beds in Mahoney Park are post-Mississippian because of the enclosed clasts. Some dark-gray limestone clasts containing large gastropods resemble Permian Hueco rocks at the southeast end of the Florida Mtns. A Permian age is favored because conditions for oncolite formation were probably less favorable(?) during Lobo (Paleocene-

FIGURE 1:32.3d. Oncolite bed of unknown age in small klippe south of Stop 2.

Eocene) time, which is the most logical other choice. However, the interbedded conglomerates do closely resemble Lobo-type conglomerates (Clemons, 1985).

Retrace route to mileage point 26.6. **5.7**

38.0 **Turn right** (north) on gravel road. **1.0**

39.0 Cattleguard. Cooke's Peak (2563 m) at 11:55 is a granodiorite laccolithic intrusive into Paleozoic and Cretaceous rocks. The K/Ar age of the intrusive is 38.8 ± 1.4 my (Loring and Loring, 1980b). Dragon Ridge at 2:00, Capitol Dome at 2:30, Florida Peak at 3:00. **1.0**

40.0 Junction, **continue straight** on pavement (Espejo Ave.). **4.0**

44.0 Junction, stop sign. **Turn right** (east). Little Florida Mtns at 12:00.

The Little Florida Mtns are a small Basin and Range fault block composed chiefly of lower Miocene rhyolite and rhyolite fanglomerate (see paper by Kiely and James, this guidebook). Irregular, domal to dike-like intrusions and short flows of reddish, aphyric, flow-banded rhyolite form bold cliffs along the western side of the range. Several of the intrusions have border zones of black, perlitic obsidian and vitrophyre. These rocks intruded, and in part, along with contemporaneous air-fall tuffs, were deposited on an angular unconformity carved on about 100 m of Oligocene ash-flow tuff and an unknown thickness of upper Eocene(?) andesite and volcanic breccia. The grayish-pink, crystal-vitric ash-flow tuff contains up to 30% phenocrysts of oligoclase, sanidine, quartz, biotite, sparse hornblende and sphene, with abundant white, flattened pumice fragments. The andesite and andesitic to dacitic volcanic breccia is believed correlative with the Rubio Peak Fm. A small exposure at the southeast end of the range records basaltic andesite eruptions after emplacement of the rhyolite and preceding deposition of about 500 m of fanglomerate. The basaltic andesite consists of vesicular and amygdaloidal flows containing intermediate plagioclase laths in an intersertal matrix (Clemons, 1982b).

A middle to upper Miocene(?) dacite fills a vent at the southeast end of the range where there has been extensive hydrothermal (and pneumatolytic(?)) alteration of the nearby air-fall lithic tuffs, rhyolite and basaltic andesite. The grayish-red dacite intrusive is a dense, hypocrystalline, aphyric rock with abundant spherulites near its margins. Deposition of manganese ores, fluorite and barite in faults cutting the rhyolite fanglomerate probably accompanied the last (dacitic) phase of volcanism (Fig. 1:44.0). **0.5**

44.5 Cattleguard. **Slow,** prepare for right turn ahead. **0.5**

45.0 **Turn right** on gravel road (Ventura Blvd.). Tres Hermanas Mtns at 12:15. **1.6**

46.6 Navajo Bill Hill at 9:00 composed of Rubio Peak volcaniclastics intruded by andesite dikes. **0.4**

47.0 Junction, windmill at 3:00, **continue straight** and then follow curve left toward Capitol Dome and Florida Peak. **0.5**

47.5 Road crosses approximate location of west Florida Mtns fault. Scarp is visible 3.2 km to the north but is covered by eolian deposits here. Post-middle Miocene basin fill is about 1250 m thick west of the fault (Clemons, 1986a). **0.5**

48.0 Junction, **bear right.** Dragon Ridge at 9:00, Mexican Canyon at 9:30. Low rounded knoll at 9:35 is composed of hornblende gneiss and gneissic granite. Crosscutting

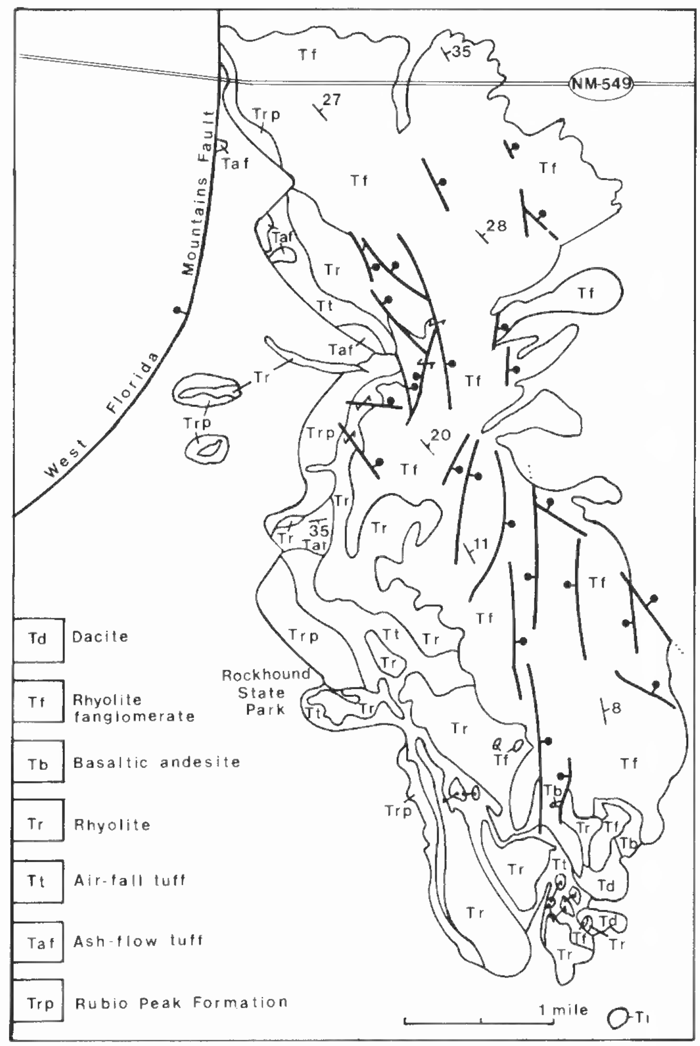


FIGURE 1:44.0. Generalized geologic map of the Little Florida Mtns by R. E. Clemons; drafted by P. A. Gresham.

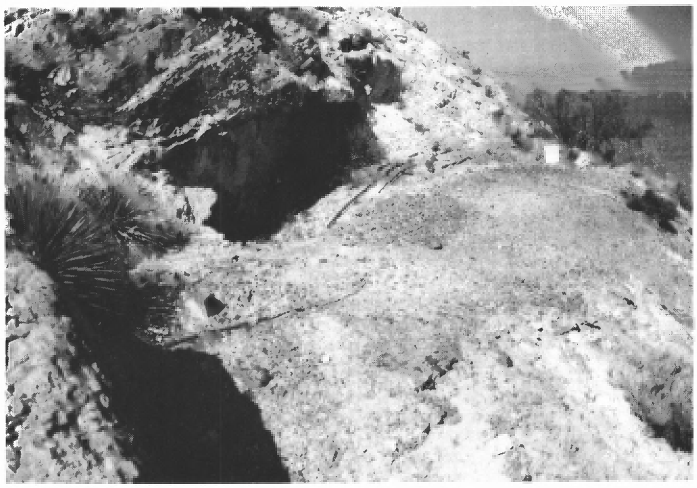


FIGURE 1:48.7a. Entrance to San Antonio Mine.

relations indicate the parent material of the hornblende gneiss is older than gneissic granite. Clemons (in press) describes the petrography of these rocks. Zircons from the gneissic granite gave Pb 207/206 ages of 1570 my (Evans and Clemons, 1987). **0.5**

48.5 Road passes under power line. Capitol Dome at 11:30. Red-brown knobs from 11:00 to 1:00 are Upper Cambrian granite. This granite is essentially same age (503 my) as the south Florida Mtns granite and is very similar petrographically (Evans and Clemons, 1988; Clemons, in press). The Capitol Dome granite contains more orthoclase and traces of oligoclase. Graphic intergrowths appear to be slightly more common in the Capitol Dome granite. Xenoliths are lacking in the granite here but are common in the syenite south of Capitol Dome. **0.2**

48.7 Junction, **bear right.** Road to left provides access to west side of Capitol Dome and abandoned lead-zinc mines (San Antonio mine, Fig. 1:48.7a). The deposits in the El Paso Fm contained cerussite and dry-bone smithsonite in gangue of limonite, calcite and quartz. Griswold (1961) estimated only small tonnages were removed from the shafts and adits. Clemons (1987) indicated the mineralization is related to an adamellite pluton underlying the Florida Mtns of the same age as the dacite vent in the Little Florida Mtns (Fig. 1:48.7b). **1.3**

50.0 **STOP 3,** south side of Capitol Dome (Fig. 1:50.0a). The geology of this area has been described by Murphy et al. (1930), Lochman-Balk (1958), Corbitt (1974) and Clemons (1984). The main reason for stopping here on this tour is to look at the Lobo Fm and discuss Laramide tectonism (see Mack and Clemons, this guidebook).

The Paleozoic section includes 15–60 m of Bliss Ss, 279+ m of El Paso Fm and 40 m of Montoya Fm. The northeast-trending rhyolite dike, southeast of Capitol Dome (Fig. 1:50.0b) is believed to have been intruded along a high-angle reverse fault similar to the south Florida Mtns fault. Upper Cambrian syenite with abundant hornfels inclusions south of this fault is juxtaposed against lower Paleozoic rocks to the north. Lobo and Rubio Peak were deposited over the eroded fault blocks.

Retrace route to mileage point 45.0. **5.0**

55.0 Junction. **Turn right** (east). Little Florida Mtns at 12:00. The light-colored ridge and slope below the white building on top of the mountain is south-dipping ash-flow

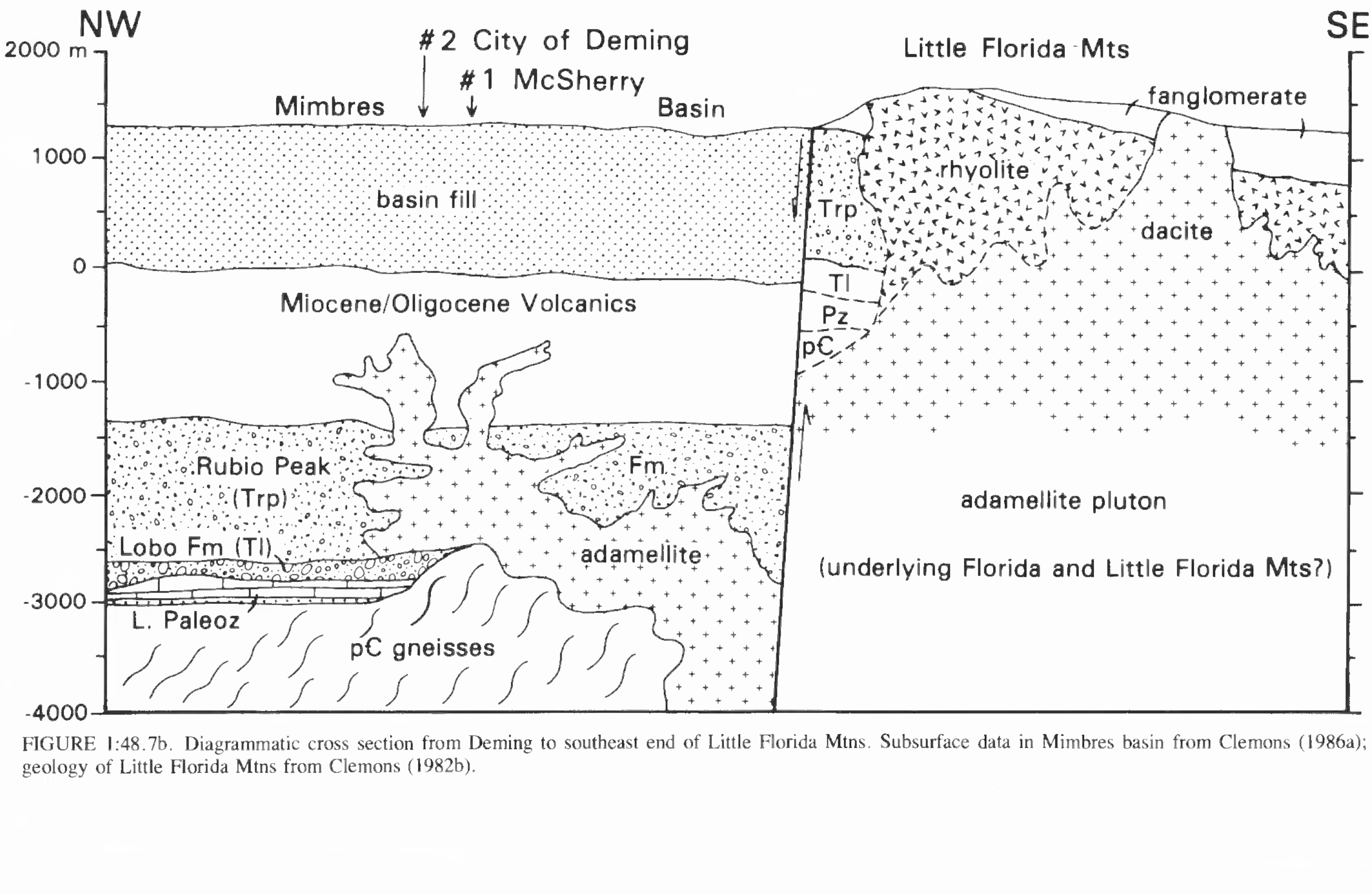


FIGURE 1:48.7b. Diagrammatic cross section from Deming to southeast end of Little Florida Mtns. Subsurface data in Mimbres basin from Clemons (1986a); geology of Little Florida Mtns from Clemons (1982b).

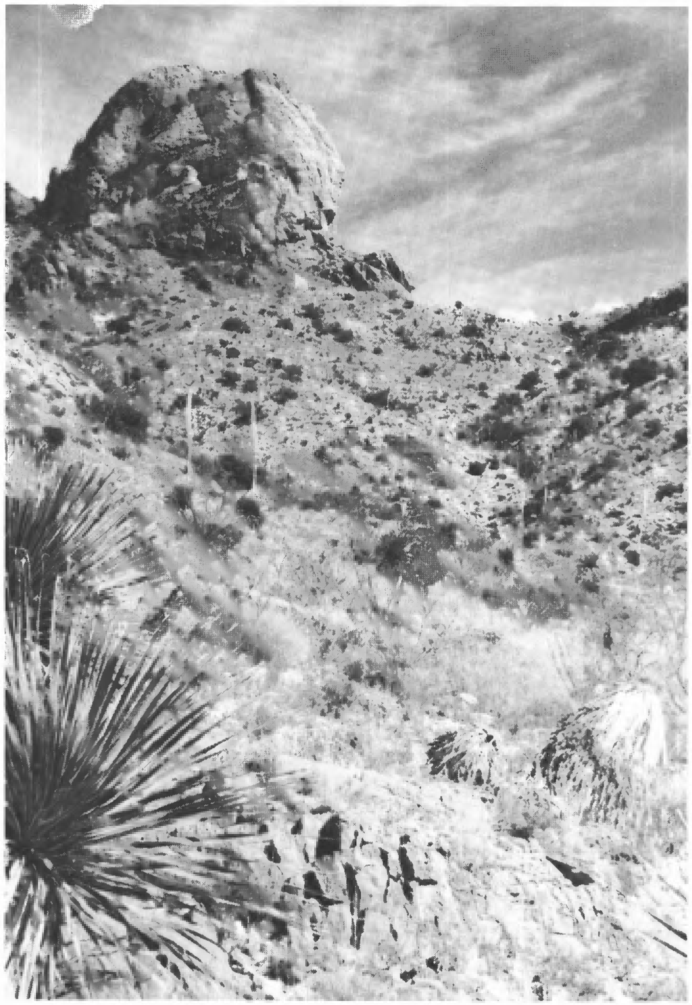


FIGURE 1:50.0a. Capitol Dome as seen from Stop 3.

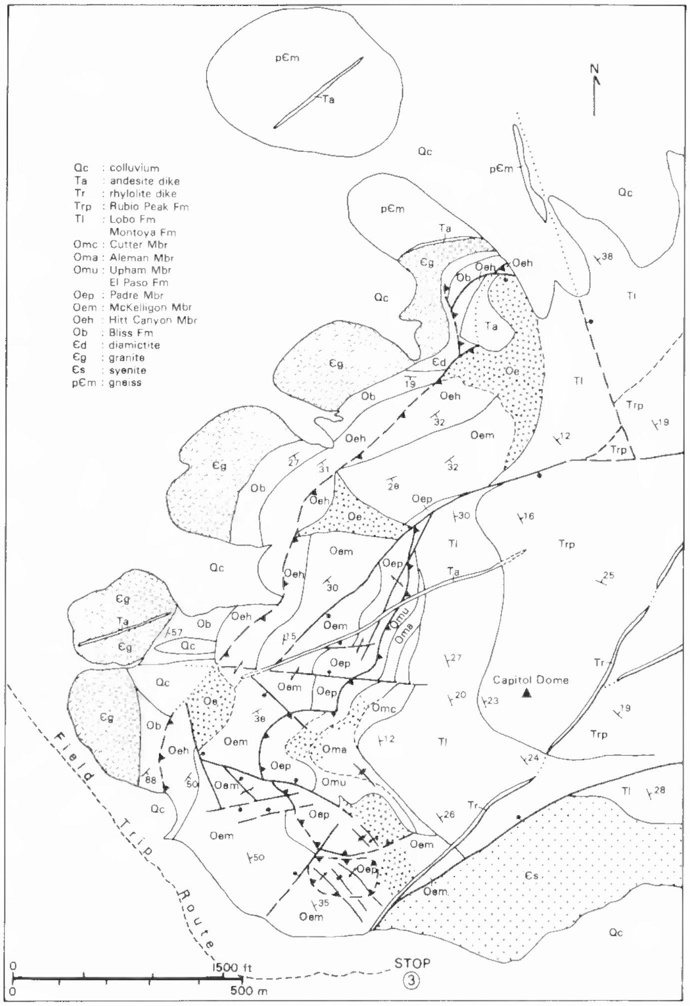


FIGURE 1:50.0b. Generalized geologic map of Capitol Dome area (modified from Clemons, 1984, and in press).

tuff underlain by Rubio Peak and intruded by rhyolite. **1.6**

56.6 Highway crosses west Florida Mtns fault. West side is down about 1250 m. **0.4**

57.0 Stop sign. **Turn left** (north) and cross cattleguard. Road to right goes to Rockhound and Spring Canyon State Parks, then through Florida Gap and down east flank of Florida Mtns. Snake Hills at 8:30, Red Mtn at 9:00, Grandmother Mtns at 9:30, Black Mtn at 10:00. **0.4**

57.4 Highway crosses west Florida Mtns fault. **0.8**

THE "DEMING DINOSAUR" WAS A MAMMOTH

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During September 1943, U.S. Army engineers removing gravel from a pit near Deming uncovered a fossilized limb bone more than four feet long. Lieutenant Paul Thielen, Public Relations Officer at the Deming Army Air Field, with the collaboration of the Deming Chamber of Commerce, brought this discovery to the attention of Dr. Stuart A. Northrop, then chairman of the Department of Geology at the University of New Mexico. Apparently, Army personnel initially identified the bone as belonging to the Late Cretaceous dinosaur *Tyrannosaurus rex*. However, based on his knowledge of the Deming area, Northrop wrote Thielen (letter, 24 September 1943) that "the chances are that it is the leg bone of one of the elephants—either a mammoth of a mastodon—rather than a dinosaur." Thus, fearing the disintegration of a poorly mineralized Pleistocene fossil, Northrop urged Thielen to ship the bone to Albuquerque, preferably by air, noting that "this would undoubtedly make a good news story, if the fact were stressed that it was a routine flight, not one made especially to bring the specimen" (letter, Northrop to Thielen, 24 September 1943).

Shortly thereafter, the bone arrived at Kirtland Field in Albuquerque, via a routine military flight, and then traveled by Army truck to the University of New Mexico. Here, Northrop confirmed his suspicion that the bone was not from a dinosaur but instead from a mammoth. A photograph of Northrop plus bone accompanying a story that clarified the bone's identity appeared in the *New Mexico Lobo* (15 October 1943) and *The Deming Graphic* (28 October 1943).

Deming's would-be dinosaur still remains on display in the Geology Museum of the University of New Mexico. The bone (catalogued as UNM P-183) is the incomplete right femur of a subadult (note the incomplete epiphyseal fusion) proboscidean (Fig. 1:57.4). The maximum length of the bone is 121 cm, and the maximum width of the shaft is 19 cm; its slender proportions thus are indicative of a mammoth instead of a mastodon (Olsen, 1972). However, no more precise identification than *Mammuthus* sp. can be undertaken.

Northrop was informed that the mammoth femur was found 25 ft (7.6 m) below the surface at a gravel pit north of the Deming Army Air Field. But, because of the gasoline shortage during World War II, he was unable to visit this location (S. A. Northrop, oral commun.

FIGURE 1:57.4. UNM P-183, right femur of subadult *Mammuthus* sp. from a gravel pit near Deming, anterior (A) and posterior (B) views. Maximum length of the bone is 121 cm.

1987). According to U.S. Department of Commerce Regional Aeronautical Chart 12M (1944), the Deming Army Air Field occupied a portion of the current location of the Deming Municipal Airport (sec. 36, T23S, R9W). Several gravel pits are now located north of the Deming Airport, but it is unclear whether one of them, or another pit, was the actual site at which Deming's "dinosaur" was discovered. I thank S. A. Northrop, B. S. Kues and K. Martini for providing information that made this note possible.

58.2 Cattleguard. **0.8**

59.0 Cattleguard. **1.4**

60.4 Cattleguard. **0.3**

60.7 Junction. Stop sign. **Turn left** (west) onto divided highway, NM-549. **1.0**

61.7 St. Clair Vineyards winery on right. **1.0**

62.7 **Continue straight.** Ventura Rd. on left. Three exploration wells were drilled about 2–4 km south and southwest of here between 1981 and 1983 by Seville-Trident Co. (Fig. 1:62.7). The No. 1 City of Deming well bottomed in basin fill or Oligocene tuffs at 1288 m; No. 2 City of Deming well bottomed in Rubio Peak Fm at 3776 m; and No. 1 McSherry well bottomed in Precambrian metamorphic rocks at 3790 m (Fig. 1:44.0) on the buried Laramide Burro uplift (Clemons, 1986a). **1.2**

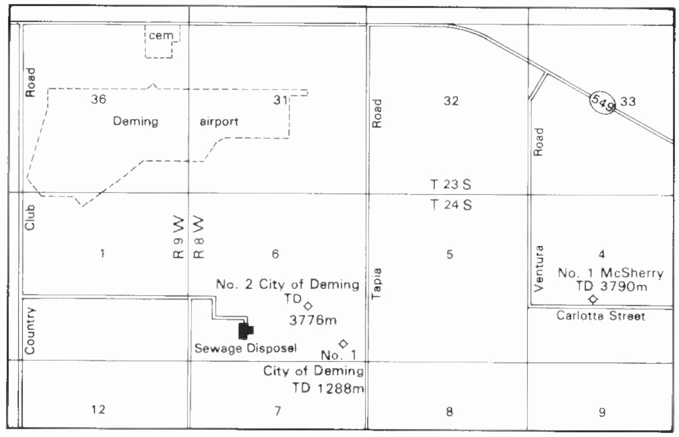

FIGURE 1:62.7. Locations of three Seville-Trident wells drilled during 1981–1983 southeast of Deming.

63.9 Deming Livestock Auction on left. Fluorite Ridge (1718 m) at 2:30 was uplifted along the north side of the northwest-trending Treasure Mtn fault. The deepest part of the Mimbres basin is probably just northeast of here near the junction of the Treasure Mtns and west Florida Mtn faults.

Tertiary granodiorite porphyry similar to that forming Cooke's Peak forms the bulk of Fluorite Ridge. Precambrian granite and gneiss and Paleozoic sedimentary rocks crop out at the southeast end, and Lower Cretaceous Sarten Ss occurs around the northern and western sides. The Lobo Fm is poorly exposed on the eastern side of Fluorite Ridge and across Starvation Draw to the southern Cooke's Range (Clemons, 1982a; Mack and Clemons, this guidebook). Fluorite veins in the granodiorite and intruded rocks produced 100000 to 200000 tons of fluorite during the active mining periods of 1909 to 1955. **0.8**

64.7 Junction, stop sign. **Deming,** founded in 1881, today has a population of about 12000. The city was named for Miss Mary Anne Deming, the bride of Charles Crocker, one of the "Big Four" founders of the Central Pacific Railroad. The Central Pacific, which joined the Southern Pacific, was built east from California through New Mexico (Fig. 1:64.7). As a result of the railroad in 1881, Deming, now the seat of Luna Co., grew to be a commercial center during the early mining and cattle boom and continues to be an important center of agriculture and stockraising to this day.

End of First-Day Road Log.

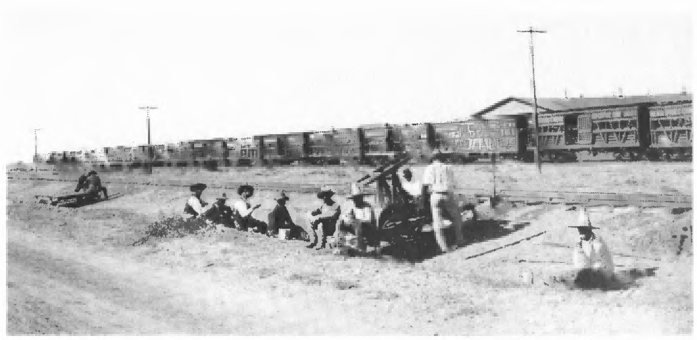

FIGURE 1:64.7. Track gang in Deming, ca. 1895. Photo courtesy Museum of New Mexico. Neg. No. 12700.

West piedmont and southern peaks of Florida Mountains, from ridge south of Tubb Spring. View is S3°E. South Florida Mountains fault passes behind smooth-appearing hills in right middle ground and out of view in upper left corner of photo. Piedmont underlain by Upper Cambrian syenite. Rugged cliffs and mountain crest south of fault are Upper Cambrian granite. Smoother low hills are composed of thrust-faulted Fusselman, Montoya and El Paso formations. Mahoney Park, site of Stop 2, Day 1, is just to left of these hills in photo. Juniper, shrubby mesquite, cactus and sparse grass are present on the piedmont. Peaks of Tres Hermanas Mountains are visible in distance at right. Camera station is in SW1/4 NW1/4, sec. 14, T25S, R8W. Altitude about 1520 m. W. Lambert photograph No. 87L24. 20 July 1987, 6:27 p.m., MDT.