Second-day road log: Northern end of Little Hatchet Mountains

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1988, pp. 15-25. https://doi.org/10.56577/FFC-39.15

in:

Cretaceous and Laramide Tectonic Evolution of Southwestern New Mexico, Mack, G. H.; Lawton, T. F.; Lucas, S. G.; [eds.], New Mexico Geological Society 39th Annual Fall Field Conference Guidebook, 216 p.
https://doi.org/10.56577/FFC-39

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SECOND-DAY ROAD LOG, NORTHERN END OF LITTLE HATCHET MOUNTAINS

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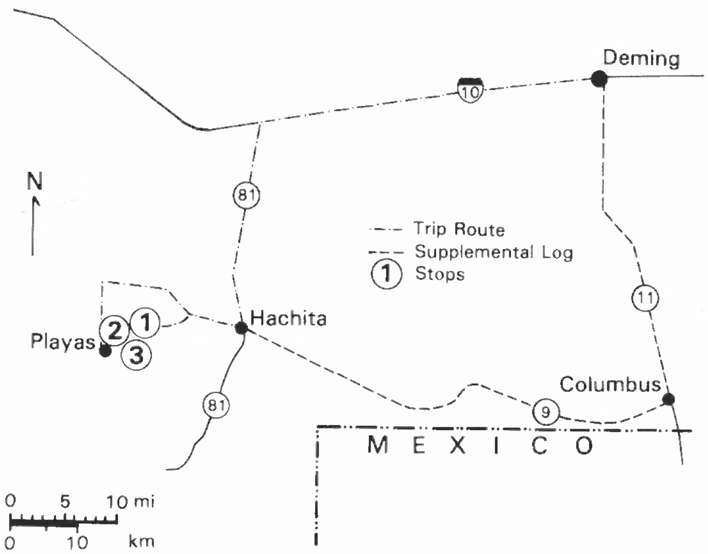
FRIDAY, OCTOBER 7, 1988



Assembly point: East side of 11th Street (heading north) at Pine Street, west side of Deming.
Departure time: 8:00 a.m.
Distance: 164.2 mi
Stops: 3

SUMMARY

The second-day tour will visit the northern end of the Little Hatchet Mountains. The route proceeds west from Deming along I-10 and then south on NM-81 to Hachita. At Hachita the route turns west onto NM-9 and then south into the northeastern end of the Little Hatchet Mountains for Stop 1. The second and third stops are in the northwestern part of the range a few miles east of the townsite of Playas. There are two primary goals for the second day: (1) to examine Lower Cretaceous stratigraphy and to discuss recent models for the origin of these sedimentary rocks and (2) to examine some of the evidence of Laramide (latest Cretaceous-early Tertiary deformation, namely thrust faults and the syntectonic Ringbone Formation. We will also see from a distance and discuss middle Tertiary volcanic rocks.

At Stop 1 we will see the basal Cretaceous unit, the Hell-to-Finish Formation, which consists of cyclically interbedded conglomerate, sandstone, silty shale and limestone of nonmarine origin. We will also see a fault contact, mapped by Zeller (1970) as a thrust, between the Hell-to-Finish and Hidalgo volcanics.

Portions of the remaining two stratigraphic units of the Lower Cretaceous section will be examined at Stop 2, where limestones of the reef and suprareef members of the U-Bar Formation grade upsection into sandstones and shales of the Mojado Formation. We will also have the opportunity at Stop 2 to see the basal 200 m of the Ringbone Formation unconformably overlying the Mojado.

Stop 3 will be devoted to the middle part of the Ringbone Formation, which displays a change from fine-grained volcanic sandstones to coarse limestone- and chert-cobble conglomerates. We will also have an excellent view of the middle Tertiary volcanic rocks along the east flank of Playas Peak.

Mileage

0.0 Begin log at I-10 Exit 81. **1.0**

1.0 Milepost 80 (MP80) (from Arizona). At 2.00 is Black Mtn (Fig. 2:1.0) which is composed of tuffaceous sed-

FIGURE 2:1.0. Black Mtn, composed of late Tertiary basalt overlying volcaniclastics.

iments overlain by upper Tertiary basalt flows. At 11:00 Red Mtn is an upper Tertiary flow-banded rhyolite dome.

Seville-Trident's No. 1 Hurt Ranch exploration well was drilled near the northern base of Red Mtn in 1983; TD was 2355 m. Tops reported by Clemons (1986a) are surface basin fill, 671 m rhyolite, 823 m Miocene-Oligocene volcanics, 1372 rhyolite, 2012 m Rubio Peak Fm, 2195 m El Paso Fm. Sam Thompson (written commun. 1984) reported the first samples, at 610 m were Lobo Fm mudstones and sandstones.

Seville-Trident's No. 1 State well is located just west of Black Mtn. It was spudded on Dec. 6, 1982, drilled to TD of 2512 m and abandoned on Jan. 21, 1983. Sam Thompson (written commun. 1984) reported the following tops after spot checks of the cuttings: 1829 m (first sample) Lobo mudstones, 1966 m Montoya Fm, 2101 m El Paso Fm, 2375 m Bliss Ss, 2418 m Precambrian granite. **2.0**

3.0 MP78. The low ridges (3 km south of Red Mtn) in the middle distance at 9:30 are the Snake Hills, which consist of the Lower Ordovician El Paso Fm and Upper Ordovician Montoya Fm. Beyond the east end of the Snake Hills is Sierra Alta in Mexico. **2.0**

5.0 MP76. Latite of Clabber Top Hill makes up most of the Grandmother Mtns from 1:00 to 2:00. The highest peaks are latite plugs, and the Little Grandmother Mtns to the northeast are 29 my ash-flow tuffs (Thorman and Drewes, 1979a). Clabber Top Hill is at 2:00. **2.0**

SYSTEM	STRAT. UNIT	ESTIMATED THICKNESS (m)	LITHIOLOGY
Tertiary	Volcanics	30	ash-flow tuff
Pennsylvanian	Horquilla Ls.	20	ls
Mississippian	Paradise Fm.	70	ls & sh
	Escabrosa Gp.	300	ls & mdst
Devonian	Percha Shale	30	sh
Silurian	Fusselman Dol.	150	dol
Ordovician	Montoya Fm.	100	dol & ss
	El Paso Fm.	340	dol & ls
Cambrian	Bliss Fm.	30	ss
Precambrian	Granite	--	granite
Total 1120 m			

FIGURE 2:19.0a. Stratigraphic units exposed in the Klondike Hills.

7.0 MP74. Cedar Mtn Range from 9:30 to 10:30. The northwest end of the Cedar Mtn Range is known as the Klondike Hills.

The Marshall Young No. 1 Bisbee Hills well was drilled to TD of 2171 m on the northeast flank of the Cedar Mtn Range in 1983. Tops reported are: surface colluvium, 30 m tuffs and volcaniclastics, 351 m Rubio Peak Fm, 549 m Lobo Fm(?), 628 m U-Bar Fm, 1535 m Fusselman Dol, 1704 m Montoya Fm, 1825 m El Paso Fm, 2113 m Bliss Ss, 2128 m Precambrian metamorphic rocks (Sam Thompson, written commun. 1986). **3.0**

10.0 MP71. Victorio Mtns from 10:30 to 11:30 contain exposures of the Ordovician El Paso and Montoya Fms and the Silurian Fusselman Dol in the eastern and southern parts. Paleozoic rocks are disconformably overlain by several hundred meters of Lower Cretaceous conglomerate, sandstone, shale and limestone and are capped by north-dipping Ringbone(?) and Eocene-Miocene(?) volcanic rocks. The Victorio Mtns have been partly mapped by Griswold (1961), and by Kottlowski (1960) and Thorman and Drewes (1980). **3.0**

13.0 Exit 68, NM-418. El Paso Natural Gas Compression Station at 3:00 in front of Clabber Top Hill. **4.0**

17.0 MP64. Grandmother Mtns (Fig. 2:24.7) at 2:00, cuestas of ash-flow tuffs at 2:30 form Little Grandmother Mtns. **2.0**

19.0 Exit 62 provides access to Victorio Mtns as well as Klondike Hills. Gage, settled in 1880, was a water station on the SP RR. Its post office was discontinued in 1965. **1.0**

KLONDIKE HILLS, SOUTHWESTERN NEW MEXICO: EVIDENCE FOR LARAMIDE STRIKE-SLIP DEFORMATION

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INTRODUCTION

The Klondike Hills are approximately 50 km southwest of Deming, at the northern end of the Cedar Mountains Range. The northwest-trending Klondike Hills are characterized by complex faulting of mostly Paleozoic rocks, with less than 190 m of relief within the map area. Stratigraphic units exposed in the Klondike Hills are shown in Fig. 2:19.0a. In many areas the Ordovician El Paso Formation has been dolomitized, which causes difficulty in distinguishing it from Sulurian Fusselman Dolomite and Ordovician Montoya Formation.

STRUCTURAL GEOLOGY

Structural geology exposed in the Klondike Hills is characterized by (1) the northwest-trending, high-angle Cedar Mountain fault; (2) two levels of low-angle faulting with both repetition and elimination of stratigraphic units; (3) smaller-scale, high-angle faulting; (4) post-Oligocene tilting (25° NNE).

The most prominent tectonic feature in the Klondike Hills is the Cedar Mountain fault (Fig. 2:19.0b), named by Thorman and Drewes (1981). It trends west-northwest in a curvilinear manner, with dips varying from steep southwest to vertical. In many locations the Cedar Mountain fault is characterized by a breccia zone ranging from less than a meter to more than 10 m in width. Cedar Mountain fault displays greater than 610 m of vertical displacement by juxtaposing Ordovician sedimentary rocks to the south with Mississippian sedimentary rocks to the north. A small exposure of Precambrian granite indicates Precambrian basement at the surface on the southern block. Cedar Moun-

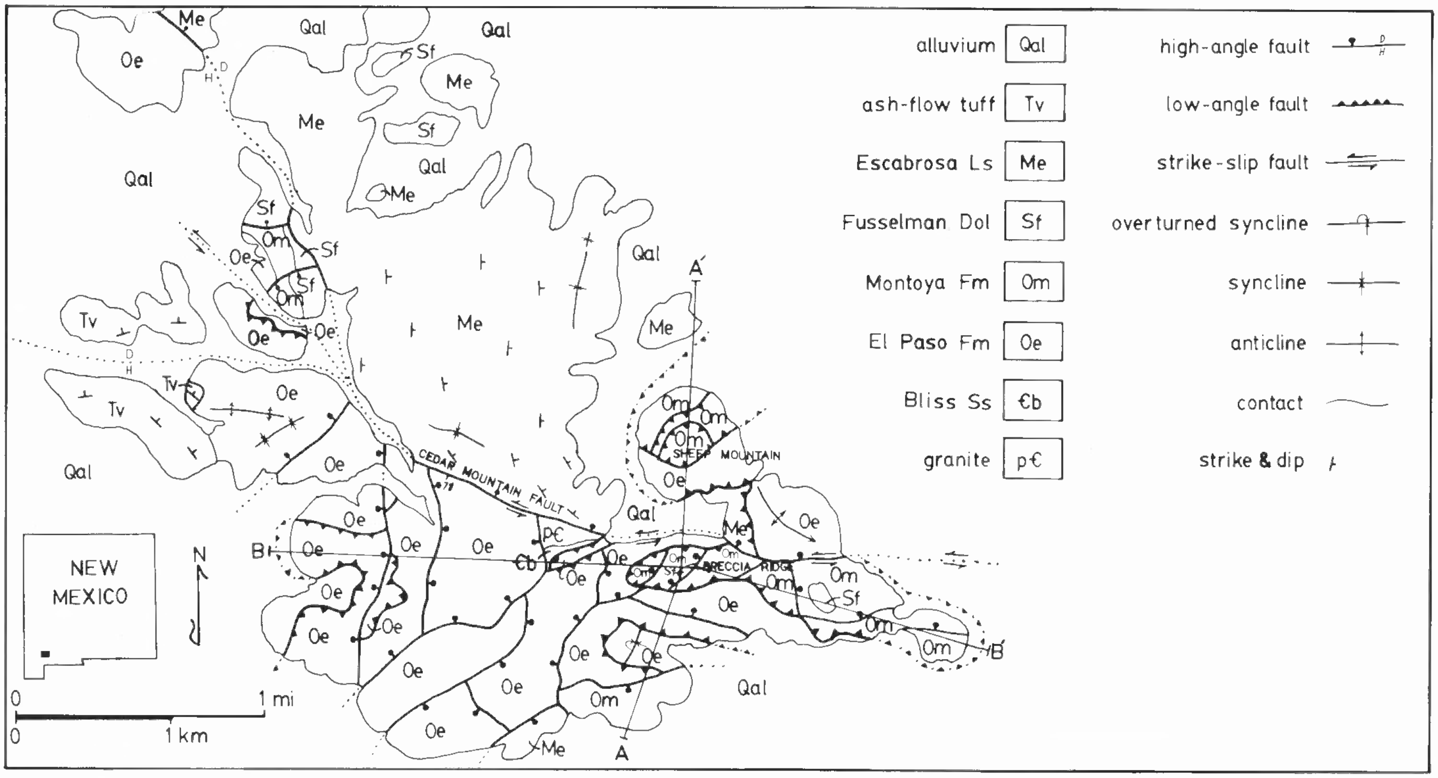

FIGURE 2:19.0b. Geologic map of the Klondike Hills, taken from Rupert (1986).

tain fault is interpreted to split into three splays in the western part of the field area. The most striking feature of Cedar Mountain Fault is apparent drag folding which suggests left-lateral strike-slip movement (Fig. 2:19.0c). No field evidence is apparent to indicate the amount of left-lateral movement.

Two levels of low-angle faulting are exposed in the Klondike Hills (Fig. 2:19.0d). The lower level places older strata on younger, thus repeating the section, with underlying beds locally overturned. The upper level of low-angle faulting is characterized by younger beds on older beds, with part of the section tectonically eliminated. These faults are termed "low-angle" instead of "thrust" faults, because for the upper level of faulting it is unclear whether the faulting is low-angle normal faulting or thrust faulting with bedding at a steeper angle than the fault.

The lower level of low-angle faulting is exposed in three locations: (1) southwest of Breccia Ridge; (2) the southwest part of the map area; and (3) along the southern base of Sheep Mountain (Fig. 2:19.0b). At the exposure just southwest of Breccia Ridge, an overturned syncline is exposed, with the fold axis oriented roughly north-south. Vergence of this overturned syncline is implied to be toward the east because the fault cuts up-section from the southwest to the area just southwest of Breccia Ridge. Bedding in the upper plate of the lower level fault is complexly folded, with highly variable orientation of fold axes.

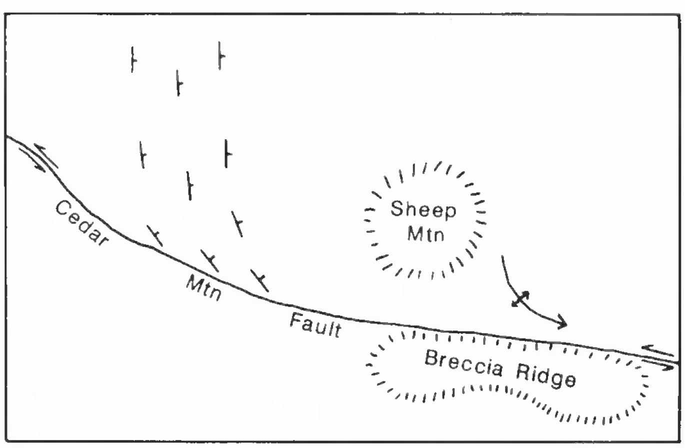

FIGURE 2:19.0c. Diagrammatic sketch of bedding features in close proximity to the Cedar Mountain fault, suggesting left-lateral, strike-slip movement.

The upper level of low-angle faulting places younger beds on older beds, with part of the section tectonically eliminated. The faulting is exposed on Breccia Ridge and on Sheep Mountain. The low-angle faulting generally follows the contact between the Cable Canyon Sandstone Member of the Montoya Formation and the thin-bedded limestones of the underlying Padre Member of the El Paso Formation, which apparently is a decollement surface. The upper plate on Breccia Ridge is intensely deformed by high-angle faults. The upper plate on Sheep Mountain is intensely deformed by both high- and low-angle faults, with the low-angle faults repeating various members of the Montoya Formation. Also, much of the upper plate exposed on both hills is highly brecciated, presumably due to the brittle behavior of the mostly dolomite and chert units. No slickensides were found on this fault surface to suggest direction of movement.

Relatively minor (less than 150 m displacement) high-angle faulting is common south of the Cedar Mountain fault. These faults appear to be high-angle as suggested by their linear surface expression, but the lack of relief makes it unclear whether these are reverse or normal faults. Crosscutting relationships suggest many of these faults postdate the low-angle faulting.

Attitudes of the Oligocene ash-flow tuff exposed in the west part of the map area (Fig. 2:19.0b) suggest that the Klondike Hills have been tilted 25° to the north by northeast. Laramide attitudes can be approximated by rotating the tuffs back to horizontal. When this is done, the Cedar Mountain fault still retains its near-vertical character, and both levels of low-angle faulting still retain their low-angle orientation.

DISCUSSION

Sheep Mountain and Breccia Ridge exhibit several similarities that suggest they may have been part of a larger allochthonous mass that has been eroded to its present form. These similarities are represented

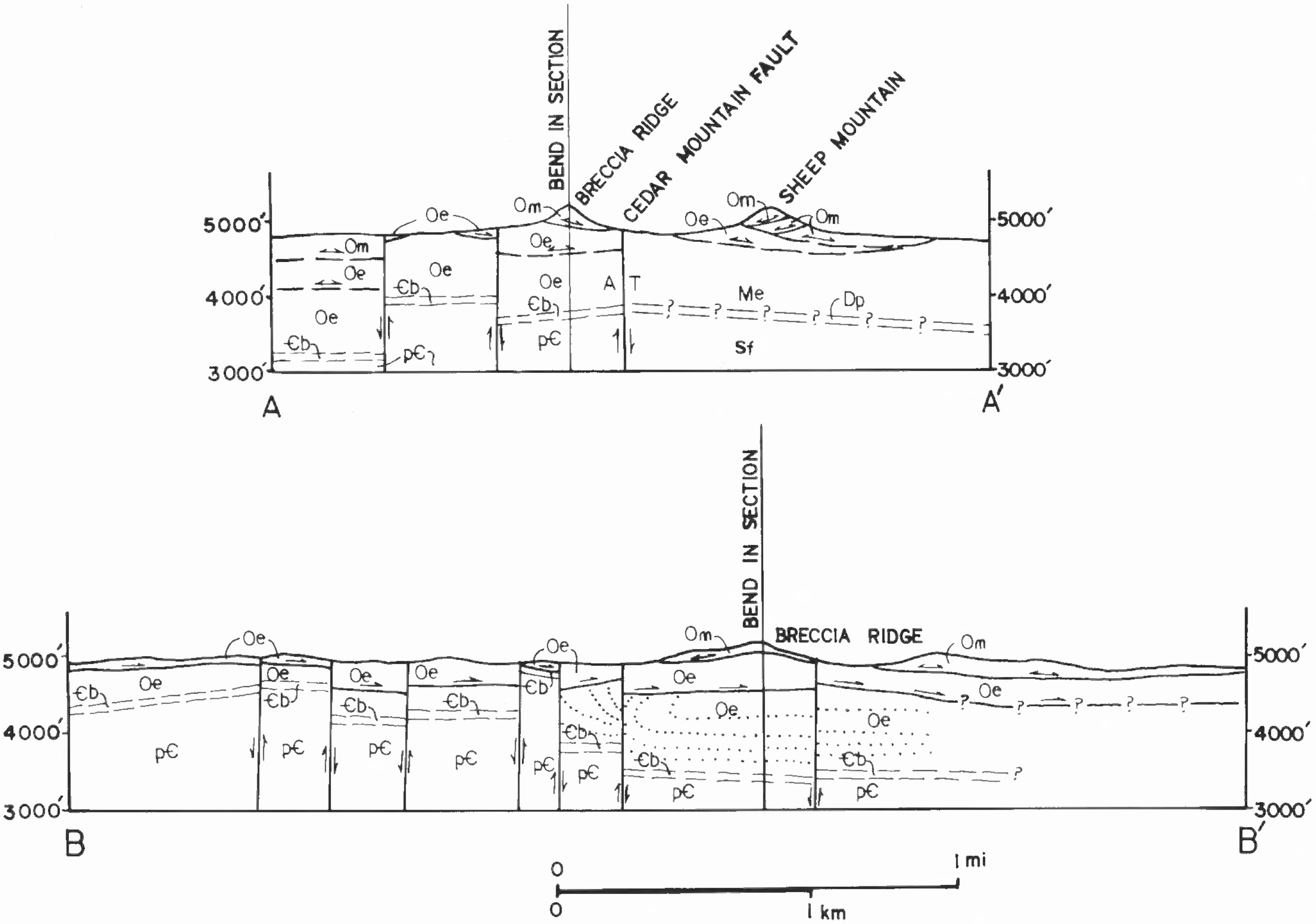

FIGURE 2:19.0d. Cross sections showing two levels of low-angle faulting. See Figure 2:19.0b for legend.

by correlative structural styles, sequences of rock units and elevations of low-angle fault surfaces.

The formative processes for the upper level of low-angle faulting exposed on Breccia Ridge and Sheep Mountain are debatable because these faults could either represent low-angle, listric normal faults (Wernicke and Burchfiel, 1982; Reynolds and Spencer, 1985), or thrust faults which are cutting at a higher angle than the underlying rocks (Brown, 1982). Resolution of this matter is not simple, as Dickinson (1984) has shown. The simplest geometrical model for the development of younger-on-older, low-angle faulting is listric normal faulting (Armstrong, 1972). Listric normal faulting has been documented on the flanks of Laramide uplifts in south-central New Mexico (Nelson and Hunter, 1986), with these uplifts presumably supplying the required slope. The intensely deformed character of the upper plate exposed on Breccia Ridge resembles that which would be expected in a listric normal fault environment. However, similar styles of faulting are exposed in the Florida Mountains, where Brown (1982) quite convincingly argued for thrust faulting. Development of a justifiable model is limited by the low relief of the area.

Comparison of the Klondike Hills to both the regional overthrust (Corbitt et al., 1978) and basement-cored block uplift models suggests that the Klondike Hills more closely resemble the basement-cored block uplift model. Features associated with regional overthrusting include dominantly horizontal movement of a thick geosynclinal sequence along major decollement surfaces, with telescoped sedimentary sequences (Woodward and DuChene, 1981). Features associated with basement-cored block uplifts include dominantly vertical movements along high-angle, basement-involved faults through relatively thin cratonic sequences, with minor thrust faults produced from drag during uplift (Prucha et al., 1965; Seager, 1983). Features which suggest the Klondike Hills more closely match the basement-cored uplift model include the occurrence of both vertical and left-lateral strike-slip movement on a high-angle, basement-involved fault (Cedar Mountain fault), with localized, small-scale, low-angle faulting in close proximity to the Cedar Mountain fault. This interpretation is consistent with work by other authors in the area (Drewes and Thorman, 1980a, b; Thorman and Drewes, 1981; Brown, 1982; Brown and Clemons, 1983; Seager, 1983; Clemons, 1986b).

It is interesting to note that this study and work by Drewes (1978, 1982) and Drewes and Thorman (1980a, b) proposed left-lateral movement on some faults in southwestern New Mexico and southeastern Arizona, whereas Seager (1983), Clemons (1986b) and Seager and Mack (1986) propose right-lateral movement on other faults in south-central and southwestern New Mexico.

CONCLUSIONS

The Cedar Mountain fault displays both vertical and left-lateral components of movement. Left-lateral strike-slip movement is suggested from drag folding of Mississippian rocks northeast of the fault. Wrench faulting is also implied by widespread, extreme brecciation and braided pattern of Cedar Mountain splay faults.

Two levels of low-angle faulting offset by younger small-scale high-angle faulting are present in the Klondike Hills. The lower level faulting places older strata on younger with underlying beds locally overturned. The upper level of faulting places younger rocks on older with varying amounts of section tectonically eliminated. Sheep Mountain and Breccia

Ridge exhibit several structural similarities that suggest they may have been part of a larger allochthonous mass that has been eroded to its present form. The allochthon may have moved in response to uplift and drag of a high-angle basement-cored Laramide block uplift, with the upper level of low-angle faulting the result of listric normal faulting off the uplifted mass, or thrust faulting at a steeper angle than the underlying bedding.

Laramide deformation in the Klondike Hills can be attributed to a combination of basement-cored uplift and strike-slip models, consistent with work by other authors in the area (Drewes and Thorman, 1980a, b; Thorman and Drewes, 1981; Brown, 1982; Brown and Clemons (1983), Seager, 1983; Clemons, 1986b; Clemons, in press), with subsequent Basin-and-Range tilting and small-scale faulting.

20.0 MP61. Rest area on right. Victorio Mtns at 9:00. **2.0**

22.0 MP59. At 1:30 are three Oligocene rhyolite domes, probably correlative to latite of Clabber Top Hill (Thorman and Drewes, 1979a). The left peak is Bessie Rhoads Mtn; the highest peak is Soldiers Farewell Hill, composed of Oligocene rhyodacite. All these rocks intruded probable Ringbone or Lobo Fm equivalents (Hedlund, 1978a).

Dark hills in the distance from 1:30 to 2:30 are the Big Burro Mtns, which consists of Precambrian granite, gneisses and amphibolites (Hewitt, 1959; Hedlund, 1978b). Little Burro Mtns at 3:00. **1.0**

23.0 MP58. At 9:30 in the distance is Big Hatchet Peak. The low hills in the foreground are the Klondike Hills, which contain complexly faulted Precambrian granite and Ordovician to Pennsylvanian sedimentary rocks (Armstrong, 1970; Corbitt et al., 1978; Thorman and Drewes, 1981; Rupert, 1986). **1.7**

24.7 Exit 55. Quincy was a former station on the SP RR (Fig. 2:24.7). **1.8**

26.5 Entering Grant County. **1.1**

27.6 Rest area on left. At 1:30 is Whitecap Hill, composed of faulted Ordovician El Paso and Montoya Fms. **1.9**

29.5 Continental Divide, elevation 1398 m. **0.5**

30.0 MP51. From 11:30 to 1:00 are Tertiary volcanic rocks of the Pyramid Mtns. At 11:00 in the far distance are the Chiricahua Mtns in Arizona. **Prepare to exit** from I-10. **1.0**

31.0 MP50. **Take NM-81 at Exit 49** to Hachita. **0.1**

31.1 **Turn left** on overpass heading south to Hachita. Victorio Mtns at 9:00. Florida Mtns (probably in haze) at 9:25, Tres Hermanas Mtns at 10:00, Klondike Hills at 11:00 **0.3**

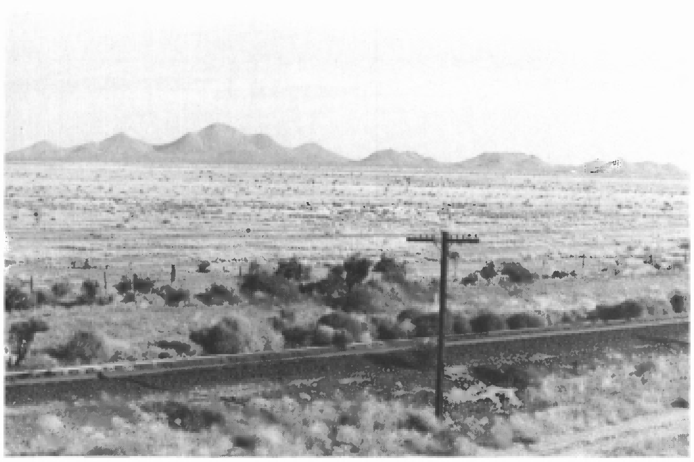

FIGURE 2:24.7. View of Grandmother Mtns from Exit 55. SP RR in foreground.

31.4 Cattleguard. Hachita 19, Antelope Wells 63. Low hills in foreground at 1:00 are The Saltys.

Marshall Young No. 1 Saltys well was drilled on the northwest side of The Saltys in 1985 to a TD of 2980 m. Reported tops are: surface Oligocene ash-flow tuff, 216 m cgl (probable Ringbone?), 235 m Epitaph Fm and fault zone, 311 m Colina Ls, 356 m Earp Fm, 657 m Horquilla Fm, 811 m Paradise Fm, 845 m Escabrosa Fm, 1085 m Percha Sh, 1145 m Montoya Fm, 1260 m (normal fault) El Paso Fm, 1362 m Bliss Fm, 1370 m (reverse fault) Mojado Fm, 2306 m U-Bar Fm, 2349 m Hell-to-Finish Fm with dioritic intrusives, 2544 m Montoya Fm, 2732 m El Paso Fm with dioritic intrusives, 2963 m Bliss Fm (Sam Thompson, written commun. 1986). The Cretaceous section below the reverse (thrust?) fault may be Ringbone Fm, and the upper part of the reported Montoya Fm at 2544 m may be Fusselman Dol. **0.4**

31.8 MP64 (from Mexico). From 10:00 to 11:00 are the Cedar Mtn Range and Klondike Hills. Big Hatchet Peak at 12:00. The northwest part of the Klondike Hills is predominantly Mississippian rock with a little Percha Sh and Horquilla Fm (Armstrong, 1970). In the distance from 12:30 to 1:30 are the Little Hatchet Mtns. Low ridges from 1:30 to 2:30 are the Coyote and Brockman Hills. **3.0**

34.8 MP61. The Saltys at 1:00 to 2:00 are composed of gently north-dipping ash-flow tuffs correlated with the Oligocene volcanics at Pothook in the Coyote Hills to the southwest (Thorman and Drewes, 1979b). Apparently the ash-flow tuffs overlie upper Paleozoic rocks in The Saltys. **1.3**

36.1 Windmill and corral at 3:00. **2.7**

38.8 MP57. At 2:30 low hills in the foreground are more Oligocene ash-flow tuffs (Thorman and Drewes, 1979b). **2.0**

40.8 MP55. Coyote Hills from 1:30 to 2:30 are mostly Oligocene volcanics of Pothook, about 34–35 my (Thorman, 1977). At 3:00 in the middle distance are the Brockman Hills, composed of the Lower Cretaceous Mojado Fm (Corbitt et al., 1977; Thorman, 1977).

The Powers No. 1 State well was drilled in 1972 about 2 km west of the Brockman Hills to a TD of 1220 m. Thorman (1977) picked tops as follows: surface, basin fill, 280 m Tertiary volcanic rocks, 360 m Cretaceous Ss, 1198 m Tertiary intrusive granodiorite. **1.0**

41.8 MP54. At 1:30 is Black Mtn (Fig. 2:41.8), a 17.9 my basaltic andesite (Thorman and Drewes, 1979a). **1.0**

42.8 MP53. Low hills at 9:00 in foreground are young Gila Cgl. **0.5**

43.3 Ranch road on right. South well. **2.0**

45.3 Road curves left. **1.5**

46.8 MP49. Apache Hills (1745 m) from 11:00 to 12:00. The Apache Hills are chiefly Oligocene volcanic rocks and a 27 my quartz monzonite stock interpreted as a resurgent cauldron. These overlie and intrude complexly folded and faulted Paleozoic rocks that were thrust over Mojado and U-Bar Fms. Abandoned Chapo, Summertime and Apache mines produced copper, silver, bismuth, lead

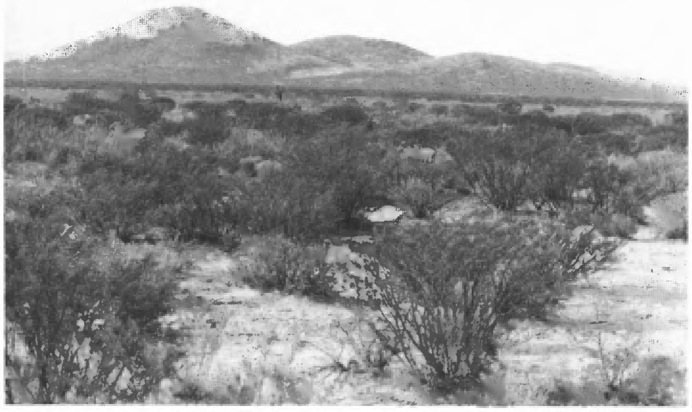

FIGURE 2:41.8. Black Mtn, composed of Miocene olivine andesite.

and zinc from skarn and veins around the Apache quartz monzonite stock (Peterson, 1976). One peak of the Sierra Rica is peeking above the Apache Hills at 11:59. Sierra Alta in the distance at 10:00. The small mesa in the foreground at 10:00 is capped by upper Tertiary basalt. **1.0**

47.8 MP48. The Big Hatchet Mtns, from 12:30 to 1:15, are composed of rocks ranging from Precambrian granitic and metamorphic rocks to Tertiary volcanics. The high peaks contain Pennsylvanian carbonate rocks (Thompson and Jacka, 1981), whereas the Precambrian and lower Paleozoic section is exposed in lower slopes just north of Big Hatchet Peak. Lower Cretaceous and Tertiary rocks are exposed along the southwestern flank of the range (Zeller, 1965, 1975).

The Little Hatchet Mtns, from 1:15 to 2:30, contain Lower Cretaceous and Tertiary rocks. Lower Cretaceous rocks include the Hell-to-Finish, U-Bar and Mojado Fms. The Lower Cretaceous section is unconformably overlain by several thousand meters of conglomerate, sandstone and shale of the Ringbone Fm, which is latest Cretaceous and/or early Tertiary in age. The Ringbone is conformably overlain by the Hidalgo volcanics of Paleozoic age or unconformably by middle Tertiary rhyolitic rocks. The section from the Hell-to-Finish through the Hidalgo volcanics is folded and cut by thrust faults (Zeller, 1970). **2.3**

50.1 Cattleguard. **Slow,** prepare to turn right. Old RR grade on right is part of branch line of Lordsburg and Hachita RR.

As the EP & SW was building across New Mexico, Dr. James Douglas of the Copper Queen mine at Bisbee persuaded the Arizona and New Mexico RR to extend their line southeastward to Hachita. This occurred in 1902 under the name Lordsburg and Hachita RR. A & NM previously ran from Morenci to Lordsburg. **0.2**

50.3 Junction of NM-81 and NM-9. **Turn right** onto NM-9 toward Playas. Village of Hachita on left. Animas 30, Rodeo 50. **0.8**

51.1 MP43 (from Arizona). Corral on right. Road parallels the former El Paso and Southwestern Railroad (Fig. 2:51.1). A circuitous 36-mi Arizona and South Eastern Railroad was built in 1888 from Bisbee to connect with a Santa Fe branch just west of Tombstone. The line's chief function was to ship ore from the new Phelps-Dodge Copper Queen mine at Bisbee. After a dispute with the Santa Fe over freight rates, a 19-mi extension was added to connect with the Southern Pacific at Benson, so Phelps-Dodge could benefit from rate competition. The SP bought the SF line that connected with A & SE west of Tombstone in 1897. In order to insure future rate competition, P-D reorganized the A & SE as the El Paso and Southwestern Railroad. Then this 209-mi line was built from Bisbee to Anapra (6 mi west of El Paso) arriving there Nov. 19, 1902. Later an extension was built westward to Tucson. After WW-I, freight traffic decreased on EP & SW due to lower copper prices and consequent decreased production. On Nov. 1, 1924, EP & SW was sold to the still prosperous SP that wanted to relieve the traffic on its line through Deming, and the two lines were operated until traffic ceased on this southern line Dec. 20, 1961. All tracks and equipment remained in place during litigation until 1963 (Myrick, 1970; Leonard, 1981). **0.4**

FIGURE 2:51.1. View west along EP and SW RR grade by Hachita station.

51.5 Cattleguard. Howells Ridge, from 10:00 to 11:00 (Fig. 2:51.5), is capped by the reef mbr of U-Bar Fm. **0.6**

52.1 MP42. Crossing the topographic center (1360 m) of the Hachita basin, that drains southward. **2.0**

54.1 MP40. At 10:30 is the abandoned mining town of Old Hachita. It is unknown when the mining of turquoise started in the Old Hachita area. Earliest recorded mineral discoveries were in the 1870s. Lasky (1947) estimated about $1 million production from the Old Hachita Eureka district to 1937. Mineralization included veins, replacement and disseminated deposits associated with probable Laramide age stocks and dikes. Ores included gold, silver, copper, lead and zinc in both primary and supergene minerals. More than 58 minerals have been reported in the Little Hatchet Mtns mining districts (Lindgren et al., 1910; Lasky, 1947). Zeller (1970) stated that American, Hornet and King mines at Old Hachita each produced $500,000 of lead and silver with small amounts of zinc and copper. Most of this ore came from replacement bodies in the U-Bar Fm. Activity has been minor and sporadic since 1950. **0.7**

FIGURE 2:51.5. Howells Ridge on west side of Hachita Valley.

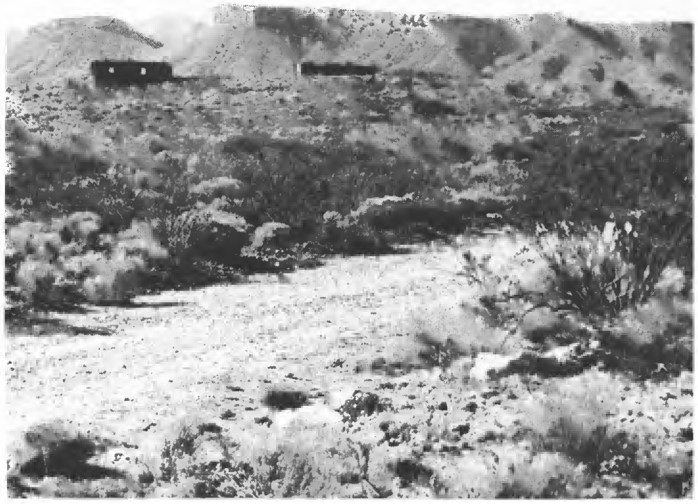

FIGURE 2:56.4. Howells Ridge viewed from Old Hachita.

54.8 **Slow,** road curves right. **Turn left onto dirt road.** Pass through gate. Continue straight at junction of dirt roads. **0.4**

55.2 Apache Hills at 9:15. Sierra Rica (1675 m) at 10:15. The Sierra Rica, on the U.S.-Mexico border, contains El Paso, Montoya, Paradise, Escabrosa, Horquilla and Earp Fms; all thrust over U-Bar and Mojado Fms. Total thickness of Paleozoic-Cretaceous sequence is about 2600 m. These rocks are overlain by middle Tertiary volcanics and intruded by stocks, dikes, sills and plugs. Contact metamorphism is widespread in the southeastern Sierra Rica. Mineralization in the abandoned Fremont district occurs as replacement bodies and veins in the U-Bar Fm. Ore reportedly contained silver, copper, gold, zinc and lead (Lindgren et al., 1910; Strongin, 1958; Van der Spuy, 1970). **0.7**

55.9 Note pedogenic calcite in cut road. **0.3**

56.2 Road crosses concealed fault and passes onto poorly exposed Hell-to-Finish cgls. **0.1**

56.3 Red color of soils comes from the Lower Cretaceous Hell-to-Finish Fm. **Bear right** at junction. **0.1**

56.4 **Bear left** at junction and head toward Howells Ridge (Fig. 2:56.4). **0.9**

57.3 Enter Old Hachita mining village (Fig. 2:57.3). **0.1**

57.4 **Bear left** at junction. Hidalgo volcanics and monzonite stocks on either side of road. **0.6**

58.0 Gate at boundary of J. M. Smith Ranch. **0.5**

58.5 **Bear left** at junction. **0.1**

58.6 **Bear left** at junction. Hidalgo volcanics poorly exposed beside road ahead. **0.2**

58.8 Windmill on right and stock tank on left. Altered monzonite and/or Hidalgo volcanics exposed on right. **0.3**

59.1 **Bear left** at junction. Mine cuts in hill from 3:00 to 4:00. **0.4**

59.5 Road crosses fault between Hidalgo volcanics and Hell-to-Finish Fm. Red-brown slopes at 3:00 are Hidalgo, light-gray slopes from 9:00 to 2:00 are Hell-to-Finish. **0.3**

59.8 **STOP 1.** Parking area is floored by the Lower Cretaceous Hell-to-Finish Fm (Fig. 2:59.8a). Steep ridge to south is Howells Ridge, which is composed of the Lower

FIGURE 2:57.3. Old Hachita.

FIGURE 2:59.8a. Cobble conglomerate in Hell-to-Finish Fm.

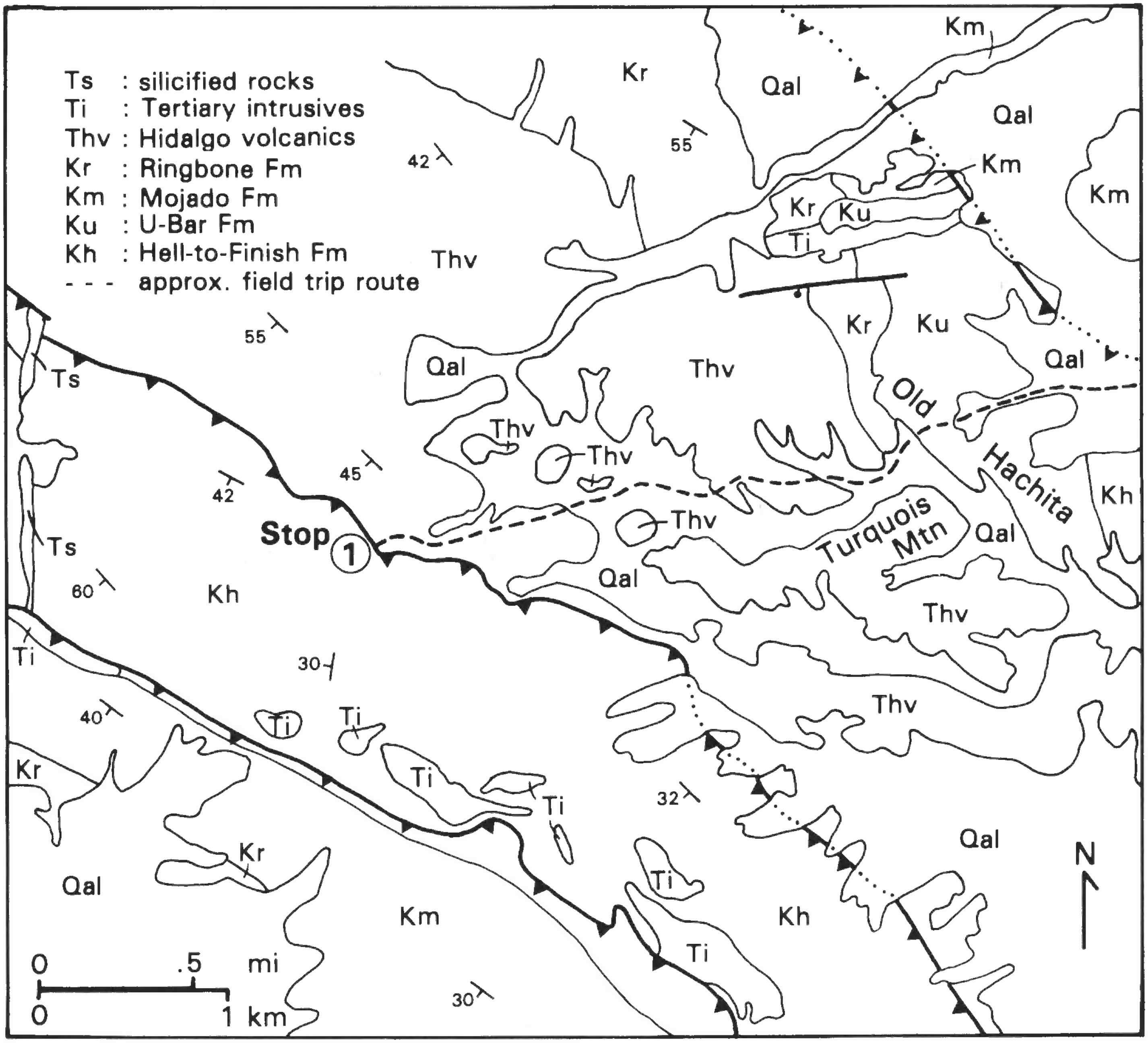

FIGURE 2:59.8b. Generalized geologic map of Old Hachita and Stop 1 area. The area of Hidalgo volcanics actually contains up to 50% monzonitic intrusives (modified from Zeller, 1970).

Cretaceous U-Bar Fm in thrust fault contact over the Hell-to-Finish (Fig. 2:59.8b). At conclusion of Stop 1, retrace route to NM-9. **5.0**

64.8 Junction of dirt road and NM-9. **Turn left** onto NM-9. **2.3**

67.1 MP39. Middle Tertiary volcanic rocks at 11:00 before highway curves right. **0.6**

67.7 Highway curves left. Southeast end of Coyote Hills at 12:00 **0.4**

68.1 MP38. The Coyote Hills are composed of Oligocene outflow sheets of ash-flow tuff interbedded with flows and volcaniclastic rocks totaling about 2000 m thick. Most of these were named volcanics of Pothook (Thorman, 1977). The lower volcanics of Pothook seem to correlate with the Bluff Creek Fm of the Animas Mtns;

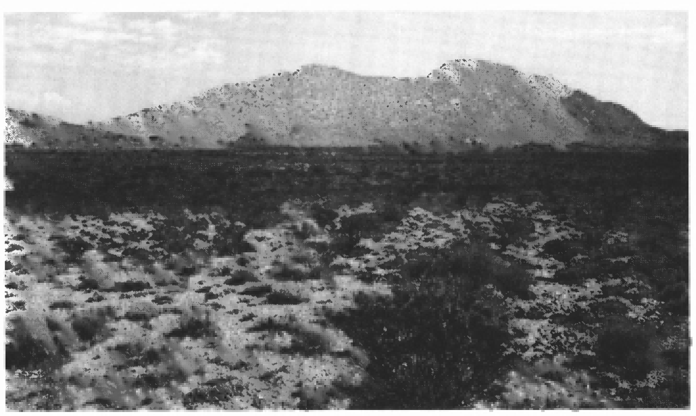

FIGURE 2:83.3. West end of Howells Ridge at Stop 2.

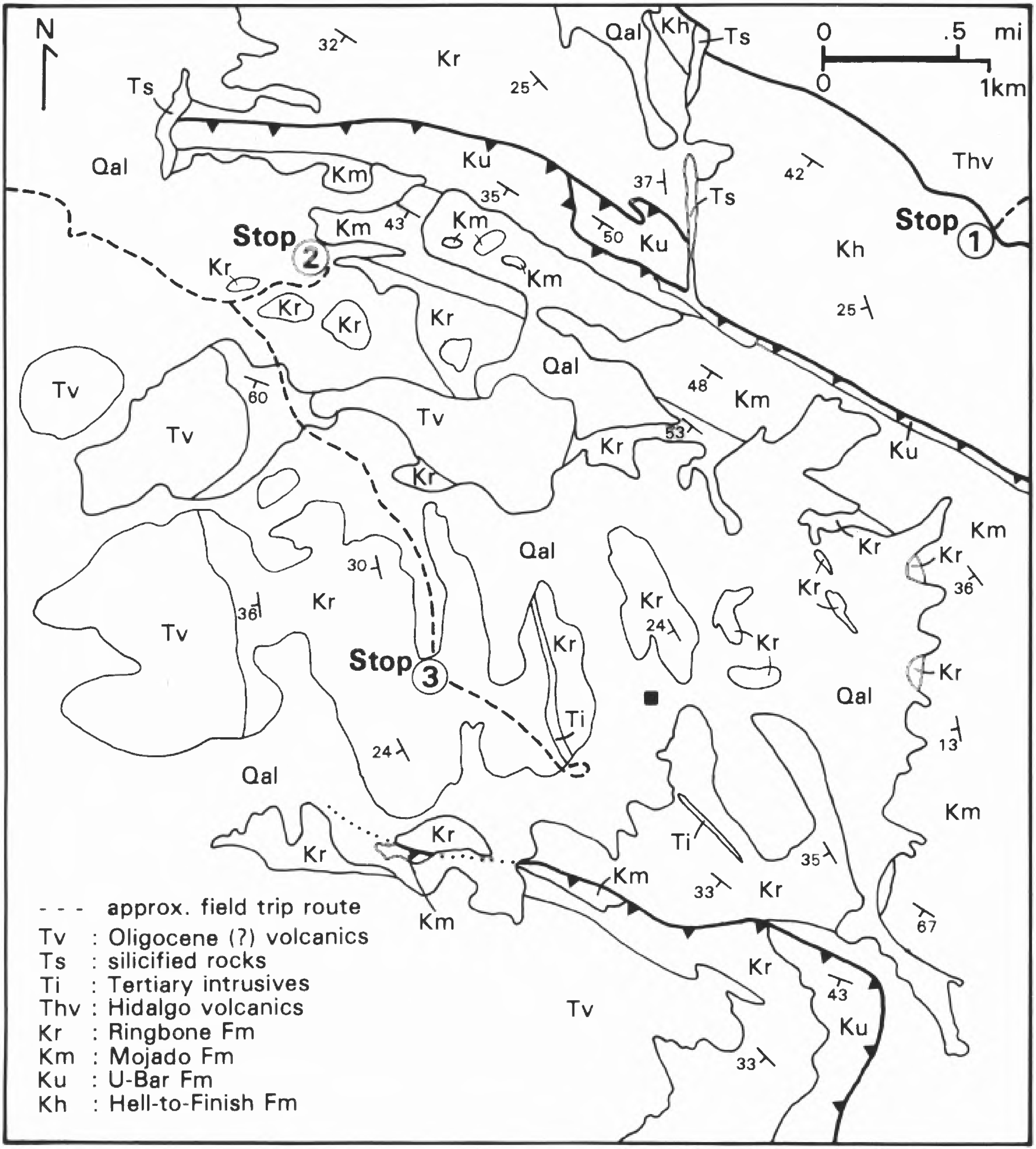

FIGURE 2:84.3. Generalized geologic map of northwest Little Hatchet Mtns showing locations of Stops 1, 2 and 3 (modified from Zeller, 1970).

the middle Pothook probably correlates with the Gillespie Tuff of the Animas Mtns; the upper Pothook seems to correlate with tuff 7 of the Rimrock Mtn Gp of the Pyramid Mtns (Deal et al., 1978). Many northwest-trending faults cut the Coyote Hills, and one is younger than the volcanic rocks. Relations of these faults to Laramide trends are interesting but uncertain. **1.0**

69.1 MP37. Highway curves right. Big Burro Mtns from 1:00 to 2:00 **0.6**

69.7 Road curves left and crosses the EP & SW railroad bed. **0.5**

70.2 Roadcut on right exposes caliche-cemented pediment gravel. **0.2**

70.4 Low hills in foreground at 9:00 contain the Lower Cretaceous Mojado Fm. Higher hills in the middle distance are underlain by the Ringbone Fm. At 3:00 are cliffs of Pothook ash-flow tuffs. **0.4**

70.8 Roadcut on right exposes Ringbone Fm which also forms low rounded knolls at 2:00, separated by fault from Pothook volcanics in upper slopes. **0.6**

71.4 Ringbone Fm exposed in gully next to the road. **0.7**

72.1 MP34. Windmill, tank and trees on right. Lower Cretaceous U-Bar Fm forms massive cliffs at 9:00. **1.8**

73.9 Windmill, tank and trees at 9:30 mark location of Pothook, a water station on the EP & SW RR. According to Schwennesen (1918), 5 or 6 families lived here, using water from a perched water table about 85 m above the water table in the Playas Valley ahead. **1.2**

75.1 MP31. Animas Mtns from 9:30 to 11:00. Chiricahua Mtns in distance at 12:00. Pyramid Mtns from 1:30 to 2:15. From 11:00 to 1:00 in the middle distance are the Peloncillo Mtns. **0.1**

75.2 Hidalgo County line. **0.9**

76.1 MP29. Ranchos de Hidalgo road to right. **Slow,** prepare for left turn to Playas Townsite. **0.2**

76.3 **Turn left** toward Playas and cross cattleguard. Phelps Dodge smelter is 14 mi to the south. **2.6**

78.9 Playas playa at 2:00. Present playa bed has an elevation of 1305 m. It extends south-southeast for about 24 km and varies from 0.1 to 2 km wide. Water depths are seldom more than a few centimeters. Schwennesen (1918) indicated that a permanent lake 10–12 m deep once occupied the Playas Valley. **1.6**

80.5 **Turn left** toward Playas Townsite. West end of Howells Ridge at 12:00. Playas Peak (1788 m), composed of middle Tertiary tuffs, at 12:30. Big Hatchet Mtns at 2:00. **1.1**

81.6 Cross cattleguard. Enter Playas Townsite. **Prepare to turn left. 0.2**

81.8 **Turn left** at stop sign onto Plaza Ave. **0.1**

81.9 **Turn left** onto Sabana Ave. **0.1**

82.0 **Turn left** into gravel parking lot next to park and playground. **Lunch stop.** After lunch, leave parking lot and **turn right** onto Sabana Ave. **0.1**

82.1 **Turn right** onto Plaza Ave; **bear right,** remaining on Plaza Ave. **0.3**

82.4 **Turn left** at stop sign onto Chaparral Ave. **0.1**

82.5 **Turn right** onto Palo Verde St. **0.3**

82.8 **Turn left** onto Montana St. **0.1**

82.9 **Turn right** onto unnamed road. Playas Peak at 12:00 **0.2**

83.1 **Turn right** at junction. **0.1**

83.2 **Turn left.** Metal gate. **0.1**

83.3 **Bear right** at junction. West end of Howells Ridge, at 10:00, composed of U-Bar reef ls mbr (Fig. 2:83.3). **0.6**

83.9 **Turn left** at junction. **0.1**

84.0 Low hills in foreground from 12:30 to 2:30 are steeply south-dipping Ringbone Fm capped with pediment gravel. **0.3**

84.3 Descend into arroyo. **STOP 2.** High ridge to north is the reef mbr of the U-Bar Fm. Zeller (1970) shows the U-Bar thrust northward over Ringbone Fm (Fig. 2:84.3). The fault must be very steeply dipping and more closely resembles a reverse fault here. Suprareef mbr of the U-Bar Fm and contact with the overlying Mojado Fm is exposed along the southern base of the high ridge. Low ridges just north of the arroyo are in the Mojado Fm. Prominent spine of sandstone just south of the windmill is also in the Mojado Fm. South of the Mojado spine, the Ringbone Fm unconformably overlies the Mojado Fm. High peaks on skyline to the south are middle Tertiary volcanics that unconformably overlie the Ringbone Fm.

After Stop 2 retrace route to junction, at mileage 83.9. **0.4**

84.7 **Turn left** at junction and pass through gate. **0.5**

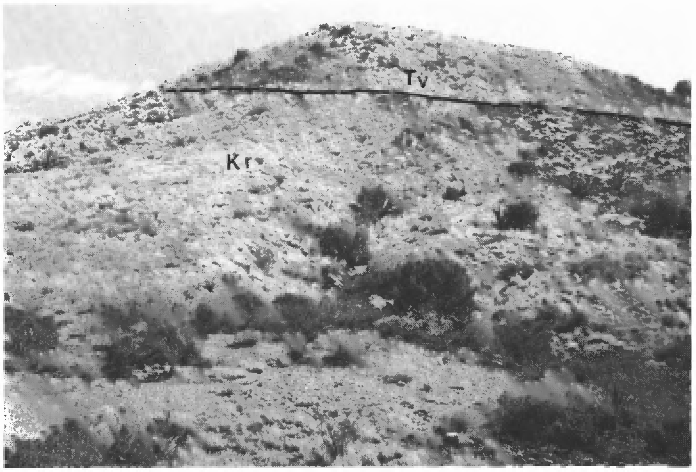

FIGURE 2:85.2a. View east toward Playas Peak showing angular unconformity between Ringbone Fm (Kr) and overlying Oligocene(?) volcanic rocks (Tv).

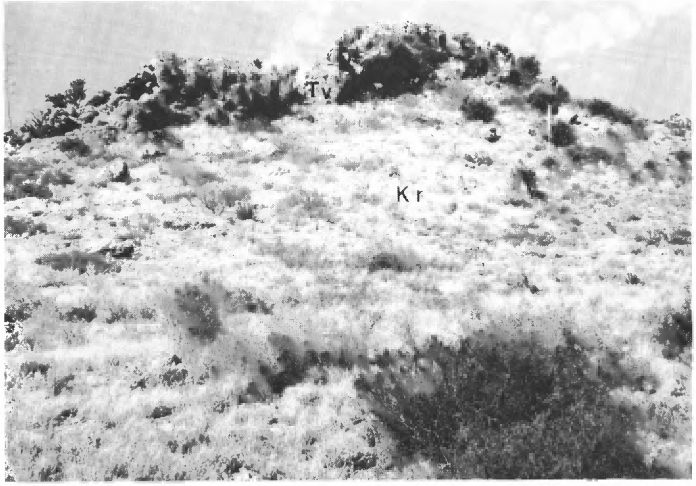

FIGURE 2:85.2b. View west of Ringbone Fm (Kr) overlain by volcanic rocks (Tv).

FIGURE 2:85.2c. View southeast of Hachita Peak (H).

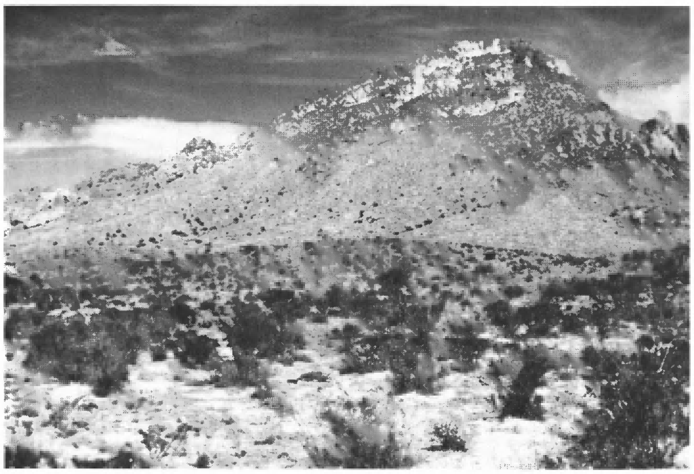

FIGURE 2:87.8. Playas Peak north of Stop 3.

85.2 At 9:00 is angular unconformity between steeply dipping Ringbone Fm below and horizontal middle Tertiary volcanics (Fig. 2:85.2a). Ringbone also forms hill at 2:30 (Fig. 2:85.2b). Distant high ridges at 12:00 are more middle Tertiary volcanics. At 11:00 in distance is Hachita Peak (2603 m), composed of Hell-to-Finish Fm and a diorite stock (Fig. 2:85.2c). Road ahead for several miles is on the Ringbone Fm. **2.0**

87.2 Descend into arroyo and **turn around.** U-Bar limestone on southwest slope of Howells Ridge from 11:00 to 1:00. **0.6**

87.8 **STOP 3.** Middle part of Ringbone Fm exposed on both sides of road. High ridge to northeast (Fig. 2:87.8) is composed of middle Tertiary volcanics.

After Stop 3, retrace route to Playas Townsite, Hachita, and Deming, via NM-9, NM-81 and I-10. **76.4**

164.2 Exit 81, Deming.

End of Second-Day Road Log.

Mahoney Park, southern Florida Mountains. View is S67°E. Baldy Peak, top center, is composed of El Paso Formation thrust over Upper Cambrian syenite which forms slopes left of the peak. Thin wedges of Bliss Formation, nonconformable on the syenite, occur below to right of the peak. Montoya and Fusselman formations form skyline ridge right of Baldy Peak. Slopes in right foreground underlain by syenite; small exposure of cliffs in upper right corner of photo composed of Fusselman thrust over syenite. Near site of Stop 2, Day 1. Sotol, ocotillo and juniper are present on slope in foreground. Mesquite, little-leaf sumac, desert willow and hackberry occur along the sandy wash. Camera station is in SE1/4 SE1/4, sec. 27, T25S, R8W. Altitude about 1500 m. W. Lambert photograph No. 87L14. 19 July 1987, 2:20 p.m., MDT.