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PETROGRAPHIC AND WELL LOG ANALYSIS OF FOUR EXPLORATION WELLS IN SOUTHWESTERN NEW MEXICO

BY

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INTRODUCTION

Marshall R. Young Oil Co. drilled two wildcat oil and gas exploration wells in southwestern New Mexico in 1983 and 1985. The No. 1 Bisbee Hills (Luna Co.) is located in sec. 11, T26S, R11W, 660 FSL, 1980 FEL (Fig. 1). It was drilled to total depth of 7120 ft; was dry and abandoned September 18, 1983. The No. 1 Saltys Unit (Grant Co.) is located in sec. 33, T25S, R15W, 660 FNL, 660 FEL. It was drilled to total depth of 9775 ft; was dry and abandoned December 21, 1985. Atlantic Richfield Exploration Co. drilled the No. 1 Fitzpatrick well (Hidalgo Co.) in sec. 10, T33S, R20W, 2220 FSL, 990 FWL. It was drilled to total depth of 10,793 ft; was dry and abandoned April 5, 1985. Originally this project was to analyze the logs and study the petrography of cuttings from these three wells. Due to structural and stratigraphic complexities (Fig. 2) identified in the No. 1 Saltys Unit, analysis of the nearby Cockrell No. 1 State Coyote well (Grant Co.) was added to the project. This well is located in sec. 11, T25S, R16W, 700 FSL, 700 FWL. It was drilled to total depth of 9282 ft; was dry and abandoned August 24, 1969 (Thompson et al., 1978).

The purposes of the study were five-fold: 1) to identify all Cretaceous and Tertiary sedimentary stratigraphic units cut by the wells; 2) to determine thickness changes of these units between these wells and outcrops in southwestern New Mexico; 3) to provide additional data on lithology of the Cretaceous-Tertiary rocks; 4) to interpret Laramide deformation based on thicknesses and lithology of the Cretaceous-Tertiary rocks; and 5) to provide additional data for the thicknesses and composition of Paleozoic rocks in the basins southwest of the Florida-Burro uplift.

Well cuttings of all four wells, collected at 10-ft intervals, are deposited with the New Mexico Bureau of Mines and Mineral Resources. All cuttings of the Bisbee Hills, Saltys, and Fitzpatrick wells were scanned under a binocular microscope. All depths cited in this report are indicated as the bottom of the 10-ft interval. Cuttings of varied intervals from the Cockrell well were also scanned. The selected intervals for preparing thin sections also depended on bracketing distinctive changes in lithologies and correlating lithology with changes in the well logs. Thin sections were prepared as follows: 1) cut a "blank" of marble about 1/2-inch thick and size of standard petrographic thin sections, 2) apply thin coat of epoxy on smooth surface of blank, 3) sprinkle clean cuttings onto epoxy surface, 4) place blank on heat plate until epoxy hardens, 5) lap smooth surface on the exposed cuttings, 6) clean, dry and apply glass slide to lapped surface with epoxy, 7) after epoxy is hardened, cut marble blank from cuttings and lap thin section of cuttings to desired thickness. Forty-eight petrographic thin sections were prepared from Cockrell No. 1 State Coyote well cuttings, 141 were prepared from No. 1 Bisbee Hills well cuttings, 204 were prepared from No.

1 Saltys Unit well cuttings, and 136 were prepared from No. 1 Fitzpatrick well cuttings. Petrographic analyses of the thin sections included identification of minerals, detrital rock grains, rock types, bioclasts and cements. Exceptionally small cuttings from the Fitzpatrick well prevented detailed identification of rock types and bioclasts. Most of these cutting were 0.1-0.5mm; a few over 1.0mm. Lithologies of the cuttings were compared with the gamma-ray and neutron-density logs to verify lithologic changes.

Regional Geology

Southwestern New Mexico lies in the Basin and Range Province. Geologic maps show about equal amounts of bedrock exposures and basin fill/alluvium (Fig. 1). Regional geologic descriptions and interpretations are based chiefly on bedrock outcrops; these outcropping rocks are predominantly middle Tertiary and younger. Consequently exploration wells drilled in the intervening basins provide much useful and essential data for interpretation of Laramide and pre-Laramide stratigraphy and structure.

Upper Paleozoic and Cretaceous rocks are thin or missing on the northwest-trending Burro-Florida uplift through central Luna and southwestern Grant Counties. Thicknesses of upper Paleozoic and Lower Cretaceous rocks increase rapidly off the southwest flank of the uplift. These rocks, and clastic wedges of Upper Cretaceous-lower Tertiary terrigenous sediments underlie parts of southwest Luna, Grant, and Hidalgo Counties. The Cretaceous-Tertiary sediments, deposited in basins along the flanks of uplifts, set the age of Laramide deformation between Late Cretaceous and late Eocene (Seager and Mack, 1986).

Stratigraphic units present in southwestern New Mexico are shown in Figure 3. Recent work has provided much new data on Cretaceous and lower Tertiary rocks. Standard stratigraphic nomenclature for Lower Cretaceous (Aptian-Albian) rocks in southwestern New Mexico was developed by Zeller (1965) who described three conformable formations, in ascending order, Hell-to-Finish, U-Bar and Mojado Formations. The Hell-to-Finish Formation ranges in thickness from 120 to 700 m. It is composed of a basal conglomerate that is overlain by conglomerate, sandstone, shale and minor limestone (Mack et al., 1986). A well-exposed section of Hell-to-Finish in the east-central Little Hatchet Mountains is predominantly siltstone with scattered lenses of granule-pebble conglomerate. The U-Bar Formation ranges in thickness from 100 to 1200 m. It is composed of shale, sandstone and limestone with limestone increasing upsection. Gradationally overlying the U-Bar is the Mojado, which consists of as much as 1500 m of sandstone, shale and minor limestone near the base. Unconformably above the Mojado is the Ringbone Formation of Campanian-Maastrichtian age (Lucas et al., 1990). The Ringbone is composed of about 1600 m of sedimentary-clast conglomerate, arkose, volcanic arenite, and gray shale (Lawton et al., 1989). Locally, overlying the Ringbone in the Little Hatchet Mountains is the Skunk Ranch Formation (Wilson et al., 1989). The Skunk Ranch consists of about 500 m of interbedded red siltstone, conglomerate, shale and sandstone in the Little Hatchet Mountains. Hidalgo Volcanics of Maastrichtian-Paleocene age overlie the Ringbone and the Skunk Ranch and possibly intertongue with both units indicating the Ringbone and Skunk Ranch may be lateral equivalents. The exact relation is uncertain but the contact locally appears gradational. The Hidalgo includes as much as 1680 m of congomerate, andesite flows, volcaniclastic sandstone and shale. Near Deming, the Lobo Formation consists of 150 to 350 m of conglomerate, sandstone and siltstone. In the Victorio Mountains west of Deming (Fig. 1), we have observed Hidalgo like clasts in the basal Lobo Formation and thus infer a post-Hidalgo age for the Lobo. The Skunk Ranch and Hidalgo in the Little Hatchet Mountains, and Lobo near Deming are overlain by an assemblage of middle to upper Eocene volcanic rocks, including the Rubio Peak Formation, of intermediate composition. These, in turn, are overlain by ash-flow tuffs and silicic volcaniclastic rocks of Oligocene-Miocene age.

Laramide structures are exposed in the Florida, Tres Hermanas, Victorio, Big and Little Hatchet, northern Animas and central Peloncillo Mountains, Sierra Rica and the Snake, Whitecap, Brockman and Klondike Hills. An overthrust model has been proposed for these structures by Corbitt (1984), Corbitt and Woodward (1973), Corbitt et al. (1977), Drewes (1978), Soule (1972), Woodward (1980) and Woodward and DuChene (1981, 1982). Most recent mappers in southwestern New Mexico have tended to favor a block-uplift model (Brown, 1982; Brown and Clemons, 1983; Clemons and Brown, 1983; Clemons, 1985, in press; Rupert, 1986; Wilson, 1986; Donnan and

Wilson, 1986; Donnan, 1987). Strike-slip movements on some of the Laramide faults have also been advocated by workers favoring the block-uplift model (Seager, 1983), as well as by Drewes and Thorman (1980a, 1980b) and Thorman and Drewes (1980). Seager and Mack (1986) provided an excellent summary of Laramide paleotectonics in southwestern New Mexico.

The major ranges today are the product of middle Miocene and younger extensional faulting. Extension may have begun in some areas as early as 28-29 my ago as postulated to the east by Seager et al. (1984). Evidence for this early extension is sparse in southwestern New Mexico. Deal et al. (1978) indicated Basin and Range faulting had to postdate the younger felsic volcanic rocks which are about 21 my old. The rhyolite of the Little Florida Mountains (23.6 my) predates uplift of the Florida Mountain block. Faulting has continued locally into late Pleistocene as evidence by fault scarps in Gila fanglomerates along the margins of the Mimbres, Animas, Hachita and Playas Valleys (Zeller, 1970; Clemons 1982, 1984; Wilson, 1986).

PETROGRAPHY

Miocene-Oligocene Volcanic Rocks

Ash-flow tuffs and silicic volcaniclastic rocks were encountered beneath alluvium and basin fill in the Bisbee Hills (0-1130 ft), Saltys (0-750 ft) and Fitzpatrick (940-5840 ft) wells. Ash-flow tuff cuttings were derived from vitric and vitric-crystal ash-flow tuffs similar to those exposed in hills and ranges near the well sites. Quartz, sanidine, plagioclase, and biotite fragments are contained in a cryptocrystalline and hyaline matrix. Tuff cuttings typically contain cuspate and platy, axiolitic shards, but there are few shards in tuff cuttings from the Fitzpatrick well. Interbedded with the ash-flow tuffs are reddish-brown silty mudstone and calcareous and siliceous fine- to medium-grained volcanic arenites. Arenite grains include chloritized and oxidized volcanic rock fragments, plagioclase, quartz, chert, and carbonate rock fragments. Lower 70 ft of this unit in the Saltys well is probably a conglomerate which also contains silty lime mudstones and bioclastic wackestones.

Rubio Peak Formation

Andesites, latites, basalts and volcanic arenites underlie the ash-flow fuff sequence in the Bisbee Hills well (1130-2085 ft) and underlie basin fill in the Cockrell well (360-2290 ft), but these rocks were not cut by the Fitzpatrick and Saltys wells. Overall lithology of this unit closely resembles the Rubio Peak Formation and other Eocene andesite rocks in southwestern New Mexico. Cuttings represent several types of hornblende andesites, porphyritic andesites, latites, and minor basalt which are probable sills or flows. Dominant rock types are reddish-brown, fine- to medium- grained, calcareous volcanic arenites. These are composed of grains of oxidized and chloritized volcanic rocks, plagioclase, hornblende and minor biotite in an argillaceous matrix. A small amount of reddish-brown mudstone is interbedded. About 150 ft of conglomerate at the base of this unit in the Bisbee Hills well also contains Paleozoic limestones, dolostone and calcareous arkose.

Lobo Formation

Rocks believed correlative to the Lobo Formation were drilled in the Bisbee Hills, Cockrell, and Saltys wells. Although exact ages of the Lobo are unknown, recent work (Lemley, 1982; Clemons and Brown, 1983; Mack and Clemons, 1988; Seager and Mack, 1986) indicates that it was deposited during late Laramide, early Eocene, time. About 2950 ft of Lobo underlies the Rubio Peak Formation in the Bisbee Hills well and 1893 ft underlie the Rubio Peak in the Cockrell well. The Saltys well intersected a major fault near the base of the Paleozoic section at 4720 ft depth and penetrated about 1260 ft of Lobo beneath the fault.

The Lobo Formation in the Bisbee Hills well contains interbedded reddish-brown silty mudstone, siltstone, and very fine- to medium-grained calcareous sandstone (Fig. 4A). Angular to subangular quartz grains, carbonate and volcanic rock fragments, chert, plagioclase, potassium feldpar and traces of biotite are present in the sandstones. Silty lime mudstone and shale with anhydrite (Fig. 4B) are common in the 210-ft interval 875 to 1085 ft beneath the top. Altered tuff or felsitic breccia (Fig. 4C) and reddish-brown mudstone interbedded with fine- to medium-grained calcareous, volcanic arenites (Fig. 4D) dominate the 1700-ft interval 1115 to 2815 ft below the top. The basal 140 ft is conglomerate containing silty shale and mudstone, calcareous fine-grained sandstone, silty limestone, dolostone, chert, and lower Paleozoic limestones. This 2950-ft section may include two units: the upper one, Lobo, of Tertiary age and the lower one correlative to the Ringbone Formation (Basabilvazo and Lawton, 1990; Lawton et al., 1989).

Interbedded reddish-brown mudstone, shale, calcareous siltstone, and claystone comprise upper 1110 ft of the Lobo Formation in the Cockrell well. Lower 740 ft is interbedded reddish-brown mudstone, calcareous fine- to medium-grained sandstone (4E), and siliceous medium-grained sandstone (4F). The sandstone contains poorly sorted, angular to subrounded grains of quartz, chert, plagioclase and minor potassium feldspar, biotite, and carbonate rock fragments. The basal 40 ft is probable conglomerate with clasts containing globigerinid-like forams (Fig. 4H, I), shale, mudstone, and siliceous, medium-grained sandstone with intergrown overgrowths. Lobo cut in the Saltys well is very similar to that in the Cockrell well but contains more sandstones. The lower 180 ft of Lobo in the Saltys well is probably conglomerate with mixed lithologies including globigerinid-like forams and mollusc fragments.

Mojado Formation

The Cockrell well cut 2477 ft of Mojado Formation (Fig. 5A, B) and rhyolite intrusions; the Saltys well cut 1520 ft of Mojado. The Mojado in the Saltys well contains fine- to medium-grained, siliceous sandstone; minor interbedded glauconitic muddy sandstone, siltstone and shale. Angular to subrounded grains of quartz, chert, plagioclase and minor potassium feldspar, and volcanic rock fragments comprise the sand fraction. Lower part of the formation contains more interbedded argillaceous coarse siltstone and calcareous very fine grained sandstone (Fig. 5C, D). Mojado in the Saltys well contains more calcareous and argillaceous sandstones, grading downward with interbedded siltstones and silty lime mudstones. There is some coarse-grained, subarkosic sandstone at the base of the Mojado in the Saltys well.

U-Bar Formation

The Fitzpatrick well penetrated about 1360 ft of U-Bar Formation beneath the Tertiary volcanic section. The U-Bar, at this site, is composed of interbedded lime mudstone, wackestone, silty wackestone, calcareous coarse siltstone and very fine- to medium-grained sandstones (Fig. 6E). Carbonate rocks are more abundant in lower part of the U-Bar and clastic rocks more common in upper part. Quartz, plagioclase, potassium feldspar, chert, and carbonate rock fragments comprise the sand grains. Bioclasts in the wackestones and few grainstones include molluscs (Fig. 6G), forams (Fig. 6C, D, F), algae, ooids (Fig. 6H), and ostracods. U-Bar sections are much thinner in the Cockrell and Saltys wells. A 195-ft interval between the Mojado and Hell-to-Finish Formations in the Cockrell well is mostly rhyolite with minor calcareous, very fine-grained sandstone, silty lime mudstone and shale. Very angular to subrounded quartz, chert, plagioclase, K-feldspar, and carbonate rock fragments comprise the sand grains. The 205-ft thick U-Bar in the Saltys well contains interbedded wackestones, muddy siltstones, and fine-grained sandstones. Allochems include fragments of Orbitolina (Fig. 6A), forams (Fig. 6B), ostracods, gastropods, bivalves, and echinoderms. Loose pollen (Fig. 6C, D) in Fitzpatrick well cuttings are suspected to have come from drilling muds. The pollen are in cuttings between 5860 and 6400 ft depths and none were observed with attached matrix or in the rock fragments.

Hell-to-Finish Formation

The Hell-to-Finish Formation was encountered only in the Cockrell and Saltys wells. The U-Bar Formation overlies Permian rocks in the Fitzpatrick well, which probably is a fault contact. The Hell-to-Finish is 695 ft thick in the Saltys well and 390 ft thick in the Cockrell well, resting on Silurian Fusselman Dolomite at both sites. It contains interbedded calcareous coarse siltstone, medium- to coarse-grained sandstones, reddish-brown siltstone and sandstone, and minor muddy siltstone and lime mudstone. Sand consists of poorly sorted, very angular to subrounded grains of quartz, chert, plagioclase, potassium feldspar and carbonate rock fragments (Fig. 7). Bioclast ghosts and mollusc fragments are present in the lower muddy siltstones.

Upper Paleozoic Formations

Upper Paleozoic rocks were cut by the Fitzpatrick and Saltys wells. About 3550 ft of neomorphosed and metamorphosed Permian-Pennsylvanian rocks underlie the U-Bar Formation in the Fitzpatrick well; 2350 ft of relatively unaltered Permian-Pennsylvanian-Mississippian rocks were drilled beneath a fault at 1050 ft depth in the Saltys well.

The Fitzpatrick well cut about 900 ft of Epitaph Dolomite directly underneath the U-Bar Formation. The Epitaph consists of brown, very fine- to fine-crystalline dolostone with a trace of bioclast ghosts. A small amount of reddish-brown calcareous, coarse siltstone is interbedded in the upper 200 ft. Underlying the Epitaph is 910 ft of Colina Formation. The upper 610 ft of Colina contains dark-gray, neomorphosed lime mudstone, wackestone, and minor light-brown, silty lime mudstone. Bioclasts include several kinds of forams, echinoderms, ostracods and gastropods. The lower 300 ft is dark greenish-gray, slightly metamorphosed calcareous siltstone. Beneath the Colina is about 1680 ft of probable Earp Formation. The upper part of the Earp contains neomorphosed lime mudstones, wackestones, and packstones with minor chert and medium-crystalline dolostone. Bioclasts include forams (including fusulinids), echinoderms, trilobites, and brachiopods. The lower part consists of fine-crystalline marble and metamorphosed calcareous, coarse siltstone and very fine grained sandstone with sericite and epidote. Beneath the Earp are 160 ft of dark-gray calcareous hornfels, with unidentifiable bioclast ghosts, probably representing the Horquilla Formation. The Fitzpatrick well was drilled 33 ft into altered medium-crystalline, mafic intrusive rock before abandoning.

The Saltys well drilled into 110 ft of Earp Formation beneath a probable high-angle fault at a depth of 1050 ft. The Earp contains interbedded reddish-brown calcareous siltstone, very fine-grained sandstone, and light to dark-gray silty limestone, lime mudstone, wackestones (Fig. 8), packstones and grainstones. Bioclasts include forams, echinoderms, bryozoa, brachiopods, trilobites and ostracods. Underlying the Earp is 440 ft of Horquilla Formation containing interbedded light- to medium-gray lime mudstone, wackestones, packstones and calcareous siltstones. There is abundant chert and neospar replacing limestones. Bioclasts include bryozoa, echinoderms, trilobites, brachiopods, conodonts, fusulinids and other forams. Mississippian rocks beneath the Horquilla include 180 ft of Paradise Formation, 400 ft of Hachita Formation and 230 ft of Keating Formation. The Paradise contains interbedded light- to medium-gray wackestones, packstones, grainstones, and yellowish-red silty limestones and calcareous siltstones (Fig. 9). Allochems inlcude ooids, peloids, forams, bryozoa, echinoderms, corals, and algae. The Hachita is mostly light-gray crinoid grainstone with minor packstones and silty lime mudstones. Some bryozoa and peloids occur in micritic beds. The Keating consists of light- to medium-gray, mostly neomorphosed, grainstones, packstones, and wackestones. Allochems include peloids, bryozoa, crinoids, brachiopods(?), and ostracods(?). Dolomitic chert is common.

Percha Formation

The Percha Formation was drilled only in the upper part of the Saltys well. There it contains 347 ft of interbedded medium- to dark-gray calcareous silty lime mudstone, dolomitic wackestone, and shale. Abundant altered intrusive rock is predominantly plagioclase laths, secondary calcite, quartz and clay.

Fusselman Dolomite

Fusselman Dolomite is present in the Cockrell (260 ft), Bisbee Hills (523 ft) and lower part of the Saltys (276 ft) wells. The 523-ft section in the Bisbee well includes the basal three informal members (Clemons, 1985) and part of the fourth member. In ascending order, these members are: lower dark-gray, lower light-gray, middle dark-gray, and middle light-gray units. Upper light- and dark-gray members have been observed only in the Florida Mountains. The middle dark-gray member is fine-crystalline dolostone; the other members are medium-crystalline dolostone.

Montoya Formation

The Montoya Formation was cut by the Bisbee (460 ft), Cockrell (223 ft) and twice by the Saltys well; 350 ft in the section above the reverse fault at 4720-ft depth and 290 ft underlying the Hell-to-Finish-Formation in the section below the fault. In ascending order, the Cable Canyon, Upham, Aleman, and Cutter Members can generally be recognized in the well cuttings. The Cutter Member consists of interbedded, light-, medium-, and dark-gray, very fine- to fine-crystalline dolostone with chert common in upper part, decreasing downward. The Aleman Member consists of interbedded, light-brownish-gray, fine- to medium-crystalline dolostone and about equal amounts of very light-yellowish-gray chert. The Upham Member is dark-gray, medium- to coarse-crystalline dolostone with minor chert; sandy at base. The thin Cable Canyon Member contains dark-gray, dolomitic medium- to coarse-grained sandstone and sandy dolostone.

El Paso Formation

The El Paso Formation underlies the Montoya Formation in the four sections described in the above paragraph. The thickest (920 ft) and least dolomitized El Paso is in the Bisbee well. There the upper unit, the Padre Member, contains interbedded light-, medium-, and dark-gray lime mudstones and wackestones; some dolostone beds are in upper part and silty to fine-sandy limestone in lower part. Below this, the McKelligon Member contains interbedded light-gray lime mudstones, wackestones and packstones; partly dolomitic in upper part. Minor silt near the base probably indicates position of the thin Jose Member that otherwise was not recognized. The lower unit, the Hitt Canyon Member, is interbedded dark-gray, medium-crystalline dolostone and medium-gray lime mudstones and wackestones; silty in lower part. Principal bioclasts throughout the El Paso are Nuia, echinoderms (Fig. 10), trilobites, sponge spicules and gastropods; intraclasts are also common. The 640 ft of El Paso in the Cockrell well and 750 ft in the Saltys well are predominantly dolostone. Minor interbedded limestones with typical El Paso allochems provide identification.

Bliss Sandstone

Bliss Sandstone was drilled below the El Paso Formation in the Bisbee and Cockrell wells and twice in the Saltys well. The Bliss is only about 40 ft thick in the Bisbee well, but a rhyolite intrusion possibly replaces another 20 ft. The Bliss is 219 ft thick in the Cockrell well and about 250 ft were drilled in the Saltys well before crossing the reverse fault into the underlying Lobo Formation. The Saltys well bottomed in Bliss, 40 ft below El Paso Formation. The Bliss consists of interbedded and siliceous fine- to medium-grained sandstones (Fig. 11), silty mudstone, medium-gray, medium-crystalline dolostone, and minor lime mudstone/wackestones. Bliss sandstones in the Cockrell well are distinctively more arkosic.

Basement Rocks

The Bisbee Hills well drilled 140 ft below the Bliss and bottomed in a quartz-muscovite schist and minor fine-crystalline granite. The granite probably is present as dikes and veins in the schist. The Cockrell well drilled 700 ft of granodiorite and granite underlying the Bliss. A 7-ft core in the bottom is fine-crystalline granite. The Fitzpatrick well bottomed in a

Tertiary(?) intrusive rock and the Saltys well bottomed in the Bliss Sandstone.

STRUCTURAL GEOLOGY

Dipmeter logs for the Bisbee Hills and Saltys wells reveal the general attitudes of strata cut by the well bore. In the Bisbee Hills well, the lower Paleozoic strata dip 10° to 20° to the south. Reliable and consistent dip and dip azimuth measurements occur only in the El Paso Formation, because the thick-bedded character of the Montoya and Fusselman formations generally inhibits microresistivity correlations. The overlying Lobo Formation dips 2° to 5°, generally to the southeast, but with a range from south to east-northeast, suggesting open folding of the unit. The Rubio Peak Formation dips 20° to the north.

In the Bisbee Hills well, the Lobo appears to rest unconformably on the Fusselman Dolomite. The dipmeter log indicates the presence of a fault at 4890 ft, about 150 ft above the contact with the Fusselman. The fault places volcanic litharenites of the Lobo against the basal conglomerate of the same formation. The presence of Lobo conglomerates above lower Paleozoic strata is consistent with geologic relations we have observed in the nearby Cedar Mountain Range, where a conglomerate that includes Lower Cretaceous clasts rests upon Mississippian strata. In the Florida Mountains, the Lobo rests directly upon lower Paleozoic formations and basement (Clemons, 1983).

Geologic relations in the deep part of the Saltys well are consistent with those in the Bisbee Hills well, with the exception that Lower Cretaceous strata are present. The lower Paleozoic section dips 10° to 20° to the southeast. The overlying Lower Cretaceous section between 6000 and 8220 ft dips consistently 15° to 25° to the south-southeast. The lower part of the Lobo between 5300 an 5700 ft dips 10° to 25° to the south-southeast, suggesting that the discordance between it and the Mojado Formation is slight. Minor faults occur at 5640 and 5800 feet.

Lower Cretaceous strata in the Saltys and Cockrell wells have comparable thicknesses when thicknesses of intrusive rocks are removed (Table 1). The measured thickness of the Lower Cretaceous is 2080 ft after removal of 300 ft of diorite from the Hell-to-Finish Formation. With dip correction, this indicates a thickness range of 1890 to 2010 ft for Cretaceous strata in the Saltys Well. After removal of seven rhyolite intrusions from Lower Cretaceous rocks in the Cockrell well, a thickness of 1925 feet was measured there. If dips in the Cockrell well are in the same range as is suggested by the comparable unit thicknesses, then Lower Cretaceous strata have very similar thicknesses in both wells.

The major structure encountered in the Saltys well is a reverse fault that emplaces a nearly complete Paleozoic section above the Lobo. Folding of the upper part of the Lobo in the well beneath the fault is demonstrated by an upsection change in dip azimuth. In the depth range between 5100 and 4700 ft, the south-southeast dips swing westward through west dips and finally to northwest dips immediately beneath the fault at 4710 ft. Likewise, the strata above the fault undergo a dip reversal within 180 ft of the fault. The Paleozoic strata in the hanging wall block dip generally to the east-northeast, ranging from north to east-southeast. Dip values and azimuths change many times in the Paleozoic section, indicating that it is both folded and faulted. Dips range from 6° to 50°, with the higher values occurring adjacent to abrupt dislocations in dip value and azimuth. These dislocations represent minor faults; generally dip values increase as the dislocations are approached, indicating folding associated with the faults (Bengston, 1981). The El Paso Formation is cut by several faults which result in its anomalous thickness. The Earp-Horquilla contact is a fault, which probably accounts for the anomalously thin Horquilla in the Saltys well. By comparison, Zeller (1966) measured 3530 ft of Horquilla in the Big Hatchet Mountains. Alternatively, the thin Horquilla may be the result of depositional thinning toward the Florida Islands (Kottlowski, 1960).

The Lobo section encountered by the Cockrell, Saltys and Bisbee Hills wells is thick relative to Lobo sections encountered in neighboring ranges. The thickest Lobo section is 2950 ft in the Bisbee Hills well and 2250 ft in the Cockrell well after removal of a single 40-ft-thick rhyolite intrusion. In comparison, Lobo exposed in the Victorio Mountains north of the

Bisbee Hills well is about 650 ft thick (Kottlowski, 1960); in the Florida Mountains, complete sections range from 100 to 500 ft (Clemons, 1984). Sections of comparable thickness occur in the Cookes Range (1150 ft) and in the Grimm et al. American Arctic Limited No. 1 Mobil 32 well (greater than 6500 ft; Seager and Mack, 1986). However, these sections lie north of the Laramide Burro uplift defined by Seager and Mack (1986); therefore, Lobo strata north of the Cedar Mountain Range but south of the Laramide Burro uplift delineate a separate depocenter that has not been previously recognized in southern New Mexico. It lies north of the reverse fault penetrated by the Saltys well. The hanging wall of this fault, or more likely series of faults, consists of Paleozoic and possibly Lower Cretaceous strata; the system trends southeast into the vicinity of the Tres Hermanas Mountains and West Lime Hills, where reverse-faulted Paleozoic and Cretaceous rocks may be seen in outcrop. We interpret limestone-clast conglomerates involved in the reverse faulting there as Lobo or its equivalent. We refer to the basin penetrated by the three oil wells and exposed in the Victorio Mountains as the Klondike basin, after the small range of hills north of the Cedar Mountain Range. The uplifted Paleozoic and Cretaceous strata to the southwest of the Klondike basin is here named the Cedar Mountain uplift.

ACKNOWLEDGEMENTS

We thank Frank E. Kottlowski, Director, and the New Mexico Bureau of Mines and Mineral Resources especially for financial assistance and for continuous support of geological investigations in southwestern New Mexico. We thank Marshall Young Oil Co., the Lordsburg Exploration Group, and Cockrell Corporation for providing the well cuttings and wire-line logs for study. We are grateful also to Sam Thompson, III and Ron Broadhead, NMBMMR, for assistance in the core and cuttings library and discussions relating to interpretations of the cuttings.

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Table 1. Measured thicknesses of Lower Cretaceous Formations after removal of intrusive-rock thicknesses from measured depths of well logs.

Thickness in feet

Formation	Cockrell Corp State Lease 1132	Marshall Young Saltys Unit #1
Mojado	1515	1520
U-Bar	210	210
Hell-to-Finish	200	350
Total Lower Cretaceous	1925	2080

FIGURE CAPTIONS

Figure 1. Southwestern New Mexico with locations of four studied wells

Figure 2. Locations of four studied wells relative to Laramide uplifts and basins in southwestern New Mexico

Figure 3. Generalized stratigraphic correlations of southwestern New Mexico and southeastern Arizona.

Figure 4. Photomicrographs of Lobo Formation cuttings.

a. Poorly sorted, fine sandy, calcareous siltstone with quartz, minor chert, carbonate rock, plagioclase, and k-feldspar grains. Silty lime mudstone cutting upper right. Bisbee Hills: 2300 ft; crossed nicols; bar = 0.5 mm.

b. Anhydrite veins in silty lime mudstone. Bisbee Hills: 3110 ft; crossed nicols; bar = 0.5 mm.

c. Left cutting is rhyolite with corroded sanidine phenocryst. Right cutting is kaolinized (minor sericite) tuff breccia. Bisbee Hills: 3600 ft; crossed nicols; bar = 0.5 mm.

d. Poorly sorted, fine, calcareous volcanic arenite with angular to subangular quartz, plagioclase, biotite, magnetite, and andesite fragments. Bisbee Hills: 3750 ft; crossed nicols; bar = 0.5 mm.

e. Calcareous fine sandstone with angular to subround quartz, chert, carbonate rock, minor plagioclase, muscovite, k-feldspar and biotite. Cockrell: 4010 ft; crossed nicols; bar = 0.5 mm.

f. Silicic, medium sandstone with quartz and minor chert grains; angularity appearance due to interlocking overgrowths. Cockrell: 4170 ft; crossed nicols; bar = 0.5 mm.

g. Silty mudstone, muddy siltstone and calcareous, fine sandstone with very angular to subangular quartz and plagioclase. Saltys: 5500 ft; plane polarized light; bar = 0.5 mm.

h. Silty calcareous mudstone with spar-filled globigerinids. Saltys: 5830 ft; plane polarized light; bar = 0.1 mm.

i. Silty, calcareous mudstone with spar-filled globigerinids and unidentified foram. Saltys; 5870 ft; plane polarized light; bar = 0.1 mm.

Figure 5. Photomicrographs of Mojado Formation cuttings.

a. Poorly sorted, silicic, fine to medium sandstone with quartz and minor chert grains; overgrowths on quartz. Cockrell: 4330 ft; crossed nicols; bar = 0.5 mm.

b. Poorly sorted, argillaceous fine sandstone with very angular to subangular quartz, chert, and minor carbonate rock fragments. Cockrell: 5270 ft; crossed nicols; bar = 0.5 mm.

c. Calcareous very fine sandstone with very angular to subround quartz, plagioclase, chert and carbonate rock fragments. Saltys: 7130 ft; crossed nicols; bar = 0.5 mm.

d. Muddy very fine sandstone with very angular to subangular quartz, plagioclase and carbonate rock grains. Saltys: 7200 ft; plane polarized light; bar = 0.5 mm.

Figure 6. Photomicrographs of U-Bar Formation cuttings.

a. *Orbitolina* fragment. Saltys: 7580 ft; plane polarized light; bar = 0.1 mm.

b. Miliolid fragment and intraclasts in wackestone. Saltys: 7580 ft; plane polarized light; bar = 0.1 mm.

c. Pollen (lower right) with cuttings of silty, neomorphosed lime mudstone and wackestone. Fitzpatrick: 5900 ft; plane polarized light; bar = 0.1 mm.

d. Pollen (right center) with cuttings of silty neomorphosed foram wackestone and calcareous fine sandstone. Fitzpatrick: 5930 ft; plane polarized light; bar = 0.1 mm.

e. Calcareous fine sandstone with subangular to rounded quartz and minor k-feldspar grains. Fitzpatrick: 6450 ft; crossed nicols; bar = 0.1 mm.

f. Miliolid-foram wackestone and neomorphosed lime mudstone cuttings. Fitzpatrick: 6490 ft; plane polarized light; bar = 0.1 mm.

g. Mollusc (probable rudist) fragment in neomorphosed wackestone. Fitzpatrick: 6590 ft; plane polarized light; bar = 0.1 mm.

h. Neomorphosed ooid grainstone fragment. Fitzpatrick: 6640 ft; plane polarized light; bar = 0.05 mm.

Figure 7. Photomicrographs of Hell-to-Finish Formation cuttings.

a. Poorly sorted, calcareous, coarse siltstone-medium sandstone with very angular to subangular quartz and minor plagioclase, k-feldspar, chert, and carbonate rock grains. Cockrell: 6850 ft; crossed nicols; bar = 0.5 mm.

b. Poorly sorted, argillaceous, coarse arkosic sandstone with very angular to subround quartz and microcline. Cockrell: 7130 ft; crossed nicols; bar = 0.5 mm.

c. Poorly sorted, coarse arkosic sandstone with kaolinized k-feldspar and quartz. Saltys: 7720 ft; crossed nicols; bar = 0.5 mm.

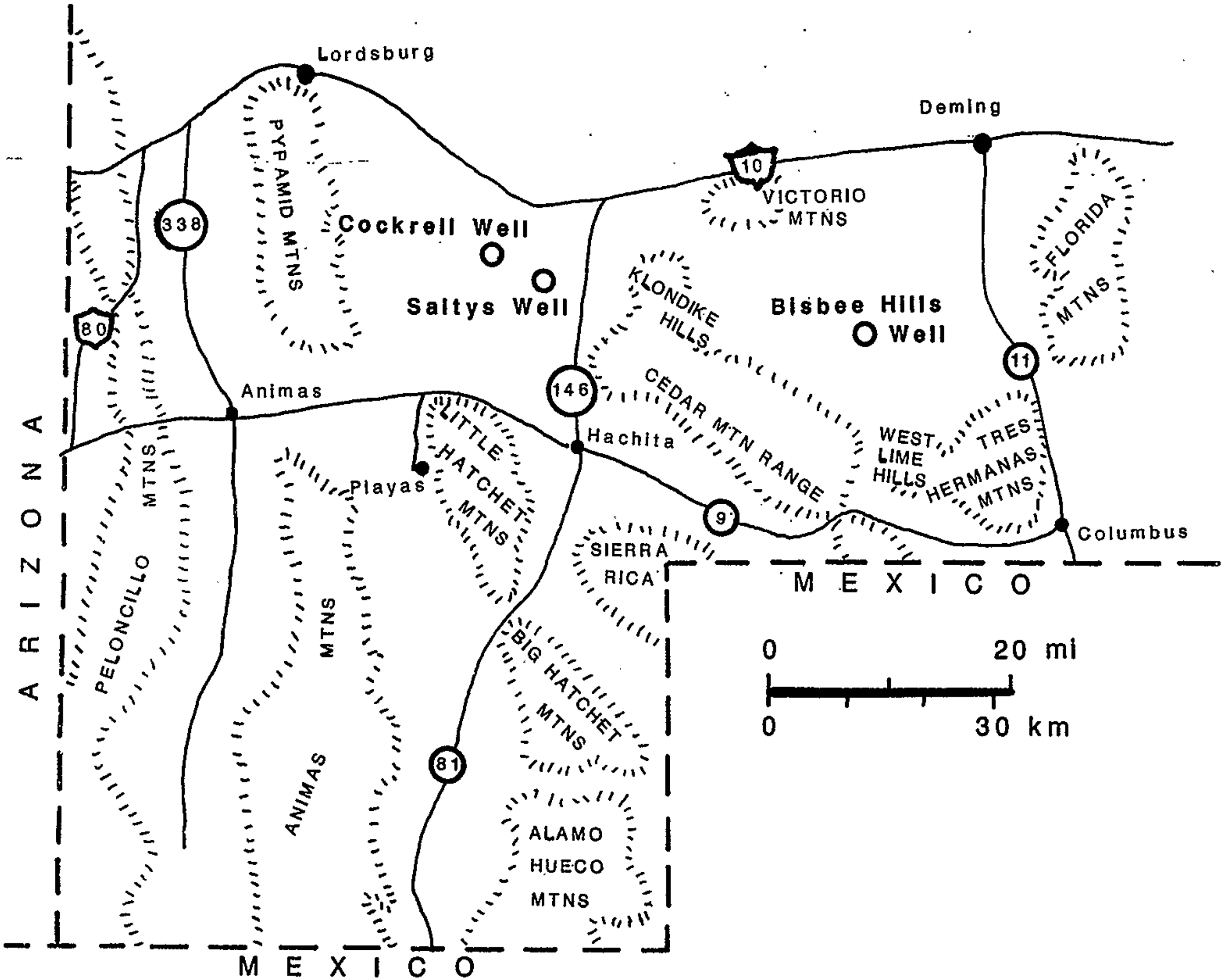
Figure 8. Photomicrograph of Earp Formation cutting. Neomorphosed echinoderm-ostracod-foram wackestone. Saltys: 1800 ft; plane polarized light; bar = 0.5 mm.

Figure 9. Photomicrograph of Paradise Formation cuttings. Silty neosparite, lime mudstone, and wackestone; ooids (upper right), echinoderms with micritized rims (left center). Saltys: 2670 ft; plane polarized light; bar = 0.5 mm.

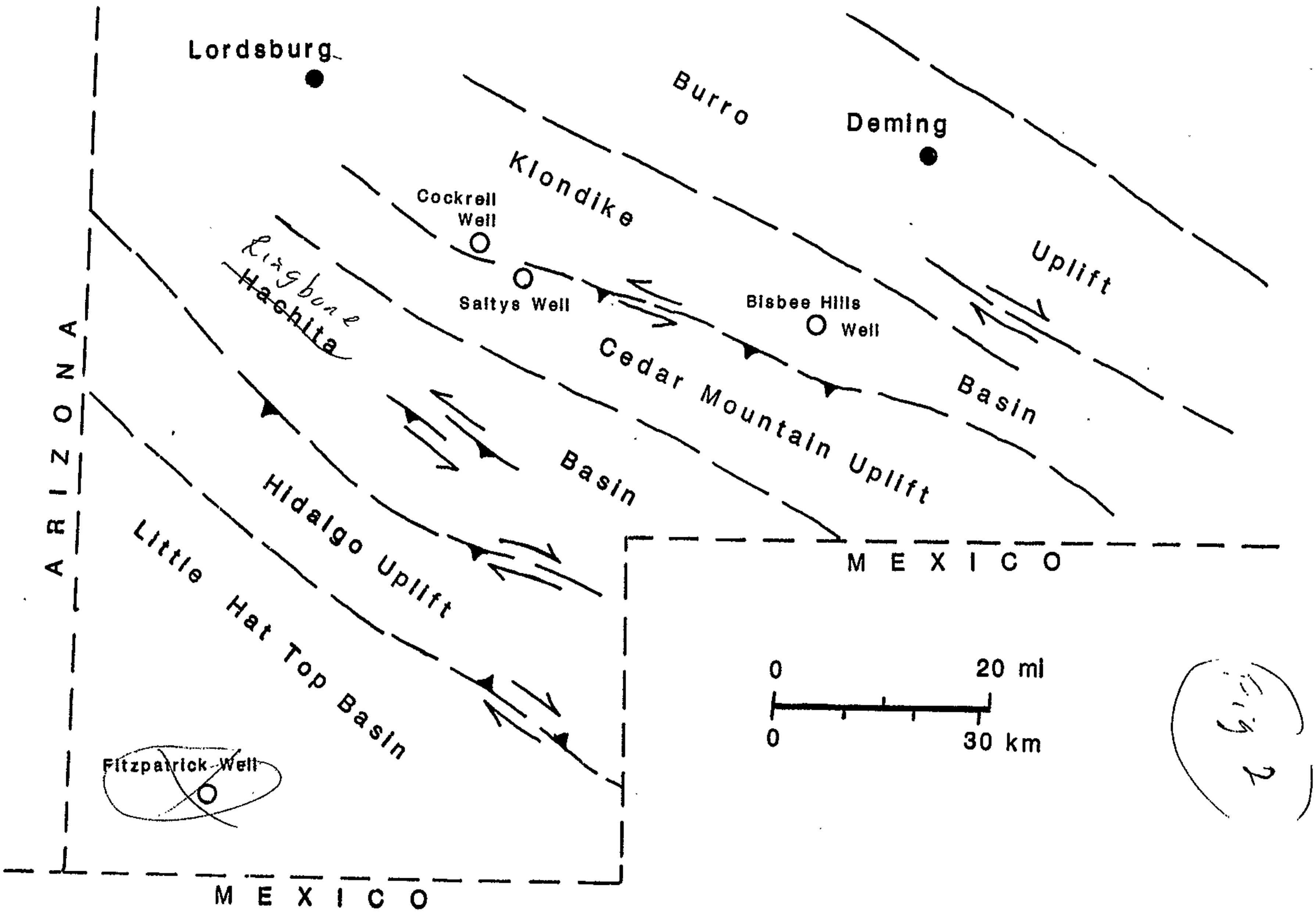
Figure 10. Photomicrograph of El Paso Formation cuttings. Nuia - echinoderm wackestone. Saltys: 9450 ft; plane polarized light; bar = 0.5 mm.

Figure 11. Photomicrograph of Bliss Formation cutting. Poorly sorted, calcareous-siliceous, arkosic fine sandstone with subangular to subround quartz, plagioclase, and k-feldspar grains; two large grains are quartz. Saltys: 9770 ft; crossed nicols; bar = 0.5 mm.

Figure 12. Interpretation and correlation of stratigraphic units in three wildcat oil tests (Coyote, Saltys and Bisbee Hills wells, Grant and Luna counties, New Mexico.



Lordsburg
Deming
10
338
PYRAMID MTNS
Cockrell Well
Saltys Well
VICTORIO MTNS
KLONDIKE HILLS
Bisbee Hills Well
FLORIDA MTNS
80
146
11
Animas
CEDAR MTN RANGE
LITTLE HATCHET MTNS
Hachita
Playas
WEST LIME HILLS
TRES HERMANAS MTNS
ARIZONA
MTNS
PELONCILLO
9
Columbus
SIERRA RICA
MEXICO
ANIMAS MTNS
BIG HATCHET MTNS
0 20 mi
0 30 km
81
ALAMO HUECO MTNS
MEXICO


Lordsburg
Deming
Burro
Klondike
Uplift
Cockrell Well
Saltys Well
Bisbee Hills Well
Ringbone
Hachita
Cedar Mountain Uplift
Basin
Basin
Hidalgo Uplift
Little Hat Top Basin
Fitzpatrick Well
ARIZONA
MEXICO
MEXICO
0
20 mi
0
30 km
Fig. 2

System	Series	Southeastern Arizona		Southwestern New Mexico
Q		Ft. Lowell Fm & equivalents		Gila Cgl & basalts
Tertiary	P			
	M			Pothook volcanics & equivalent caldron sequences
	O	Rillito Fm Rhyolite Ash-Flow Sequences		
	E	Nipper Fm		Rubio Peak Fm Lobo Fm
	P			Hidalgo Vols/ Skunk Ranch Fm
Cretaceous	U	Caldron Sequences Ft. Crittenden Fm		Ringbone Fm Colorado Fm
	L	Bisbee Gp	Cintura Fm Mural Fm Morita Fm Glance Cgl	Mojado Fm U-Bar Fm Hell-to-Finish Fm
		Bathtub Fm Temporal Fm		
J TR				
Permian	U	Rainvalley Ls Concha Ls	Naco Gp	Concha Ls
	L	Scherrer Fm Epitaph Fm Colina Ls Earp Fm Horquilla Fm		Scherrer Fm Epitaph Fm Colina Ls Earp Fm Horquilla Fm
Penn	U			
	M	Black Prince Ls		
Miss	U	Paradise Fm		Paradise Fm
	L	Hachita Fm Keating Fm	Escabrosa Gp	Hachita Fm Keating Fm
Dev	U	Swisshelm-Portal Fm Martin Fm		Percha Sh
	M			Onate Fm?
	L			
Sil	U			
	M			Fusselman Dol
	L			
Ord	U			
	M			Montoya Fm
	L			El Paso Fm
Cam	U	Abrigo Fm		Bliss Ss granite & syenite
	M	Bolsa Quartzite		
	L			

Clemons Lawton Fig 3

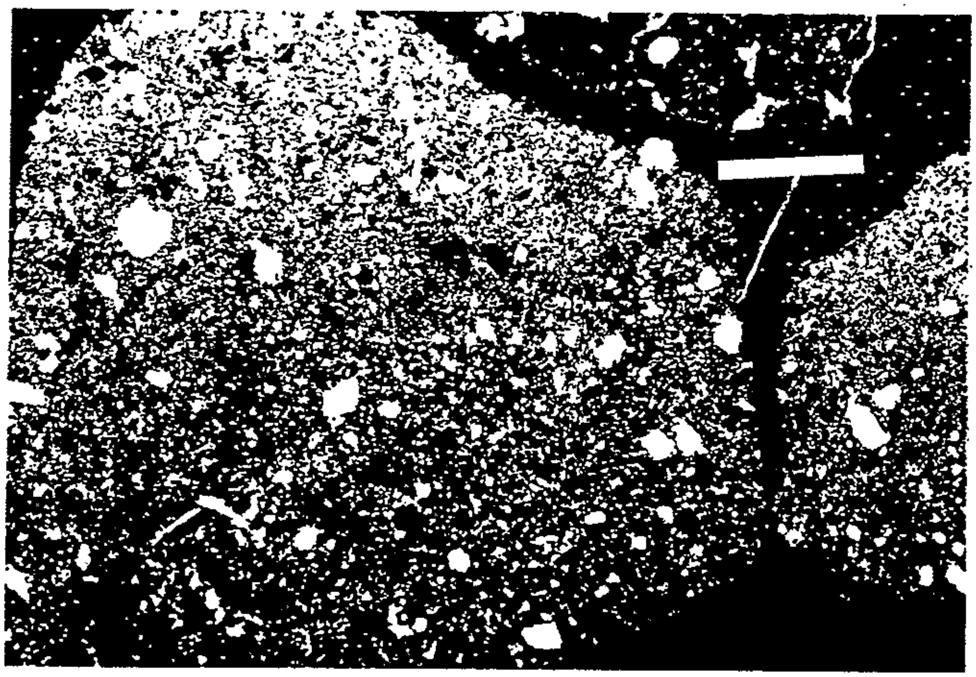


Fig. 4A

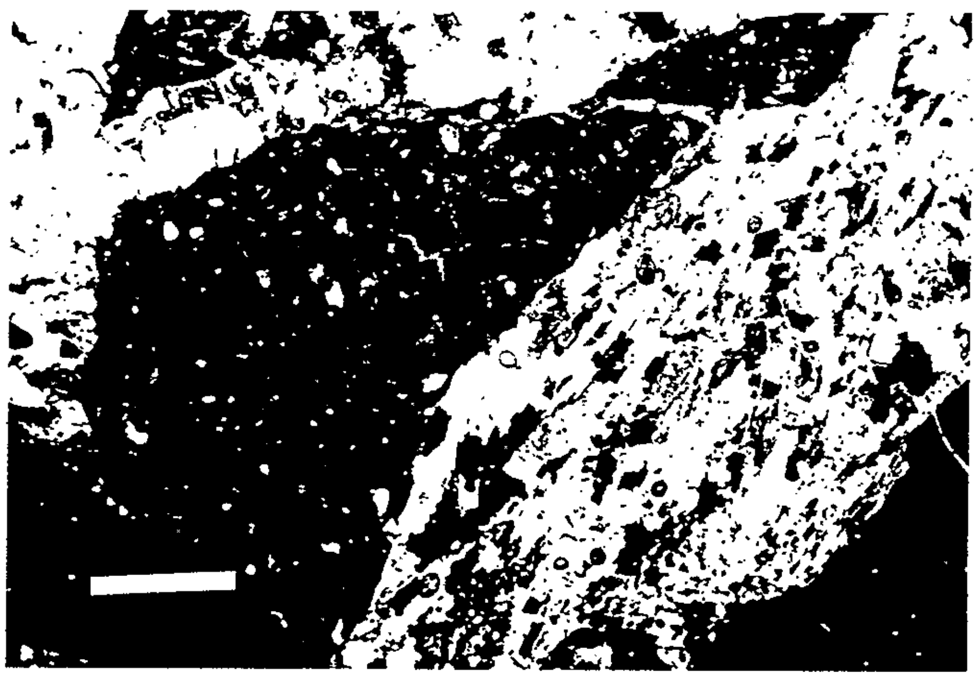


Fig. 4B

Fig. 4C

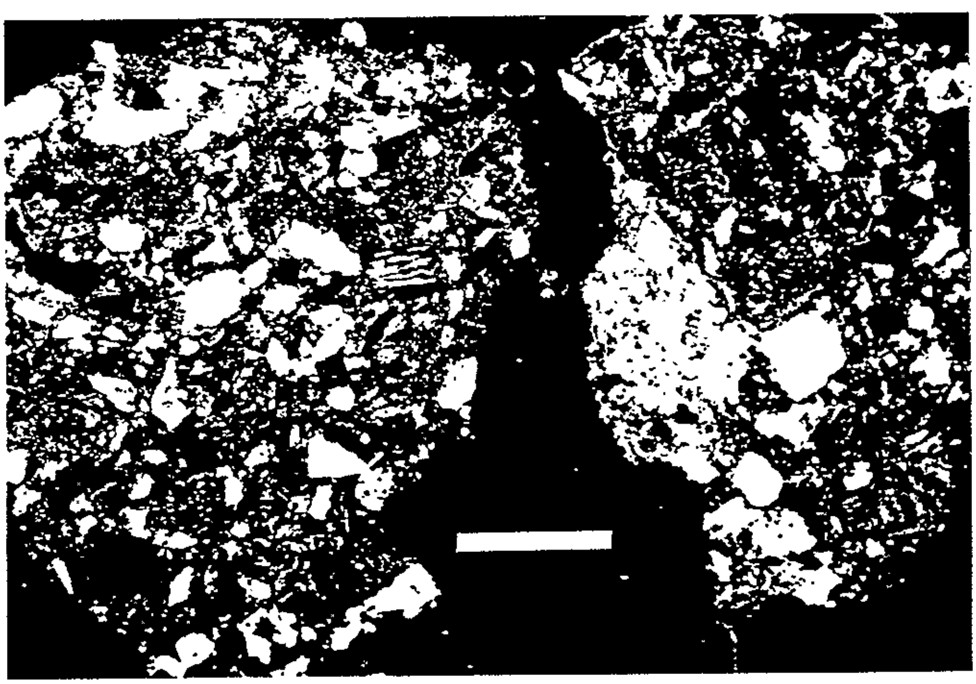


Fig. 4D

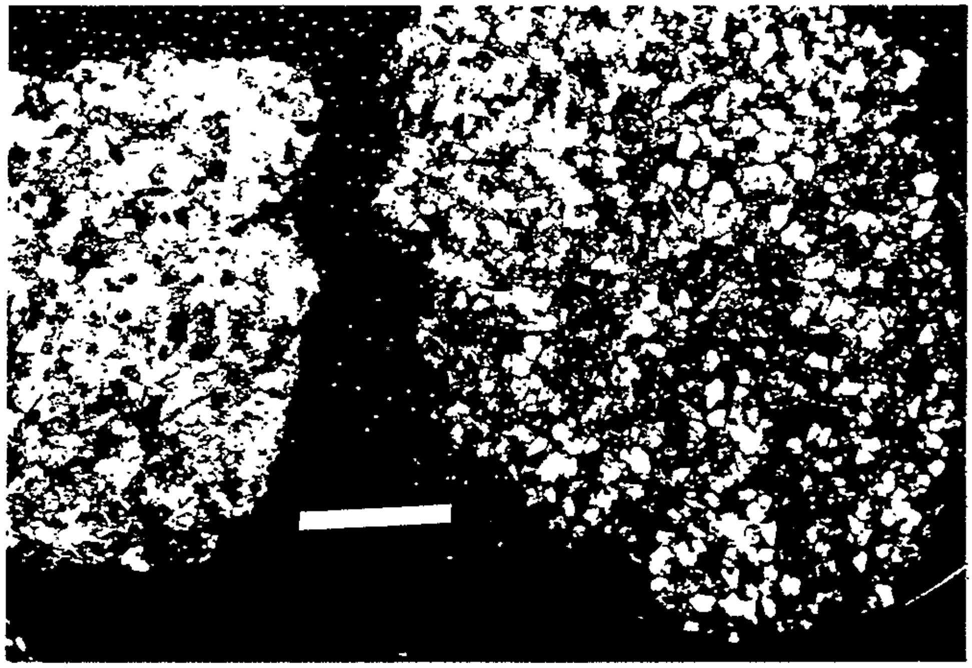


Fig. 4 E

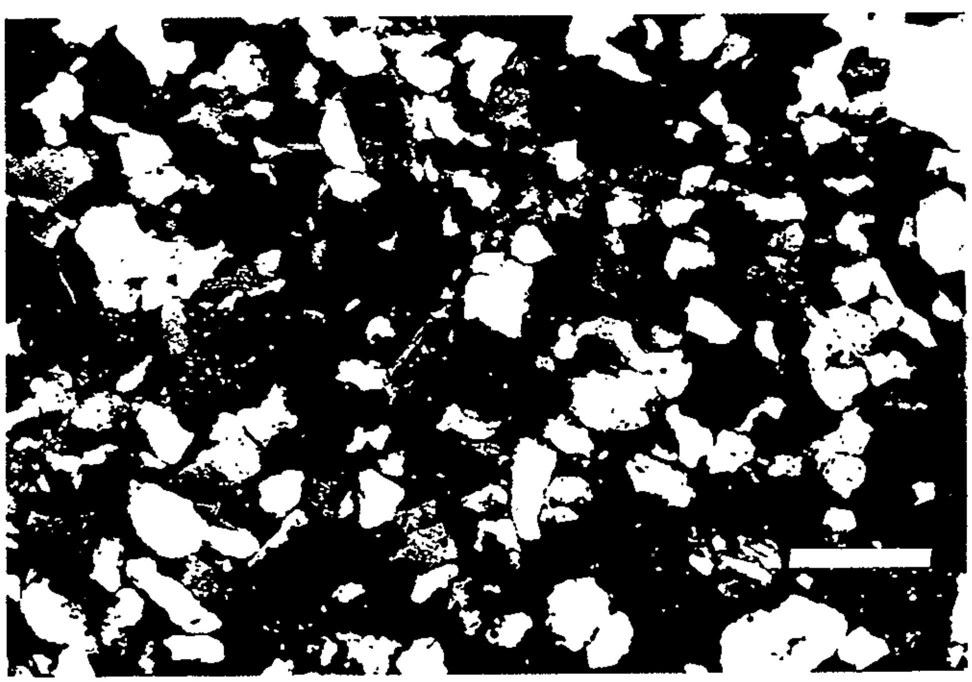


Fig 4 F

looks like recycled Mojado(?)

Fig 4 G

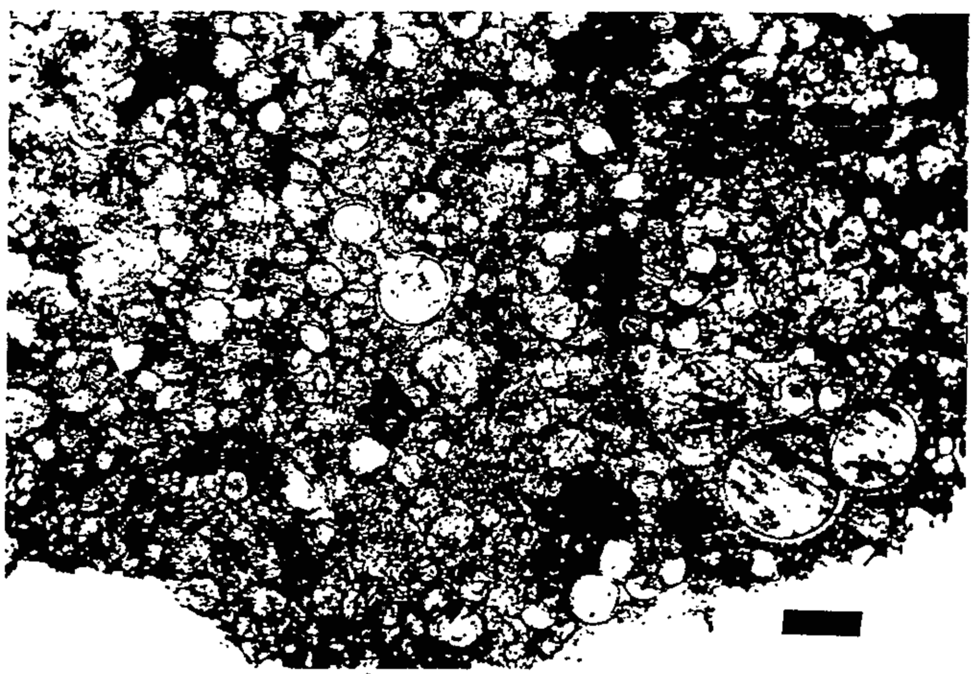


Fig 4 H

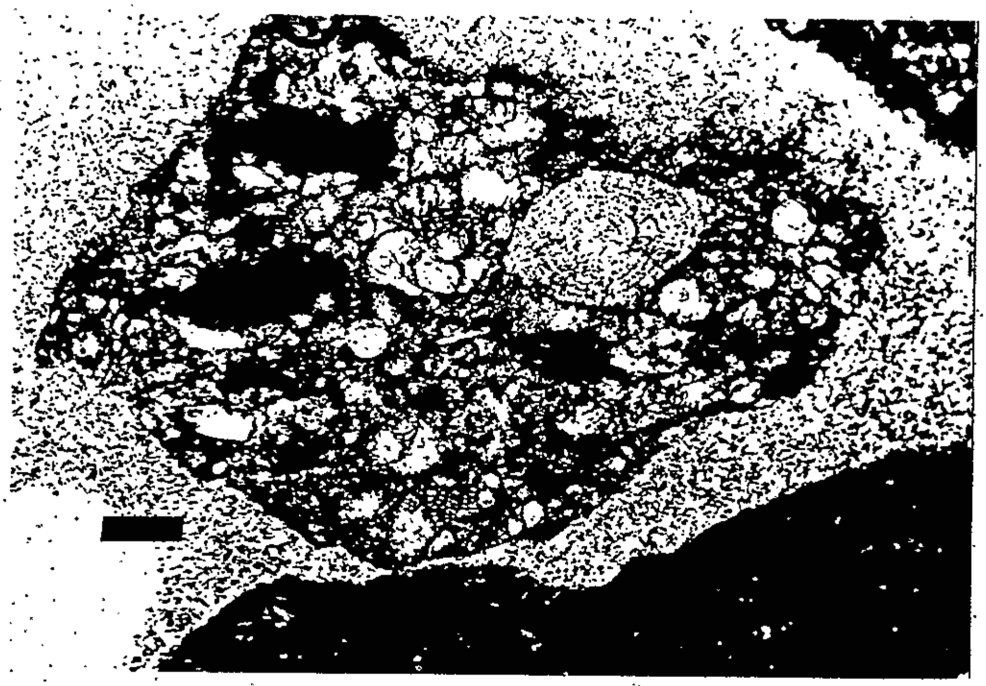


Fig 4I

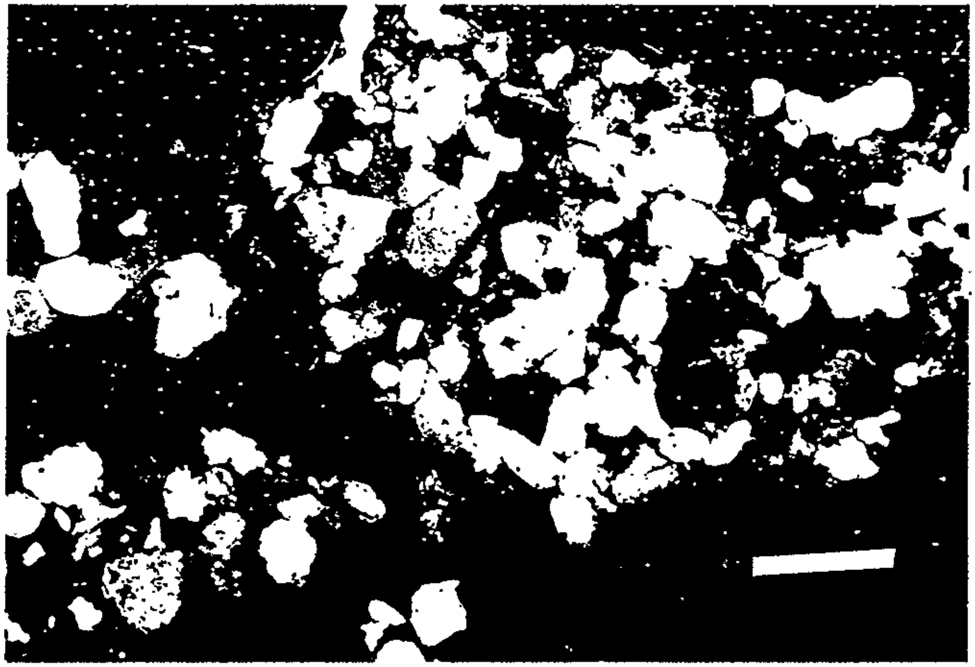


Fig. 5A

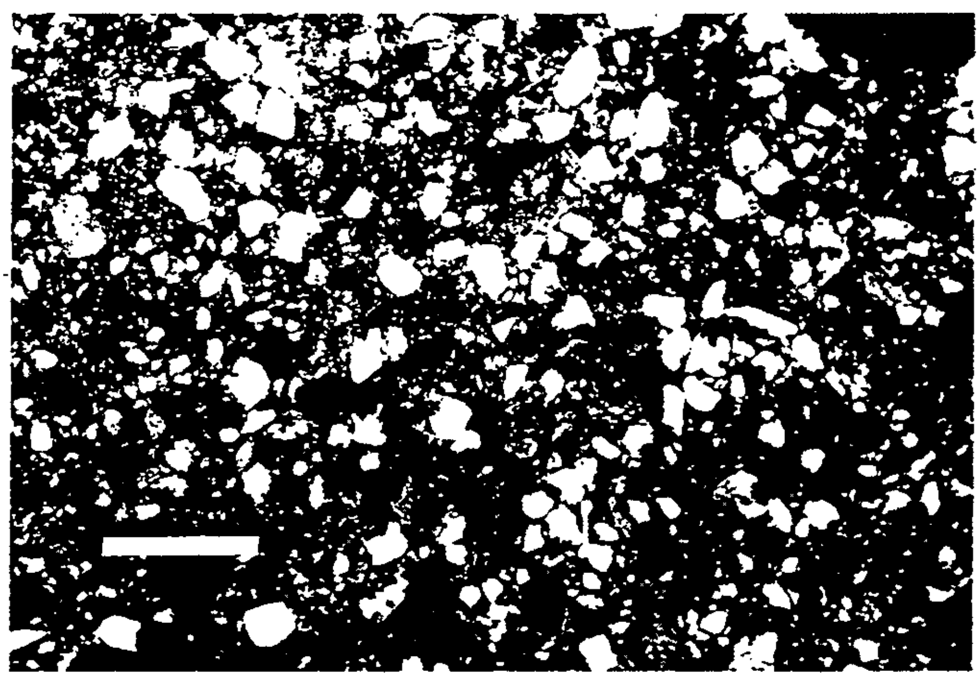


Fig 5B

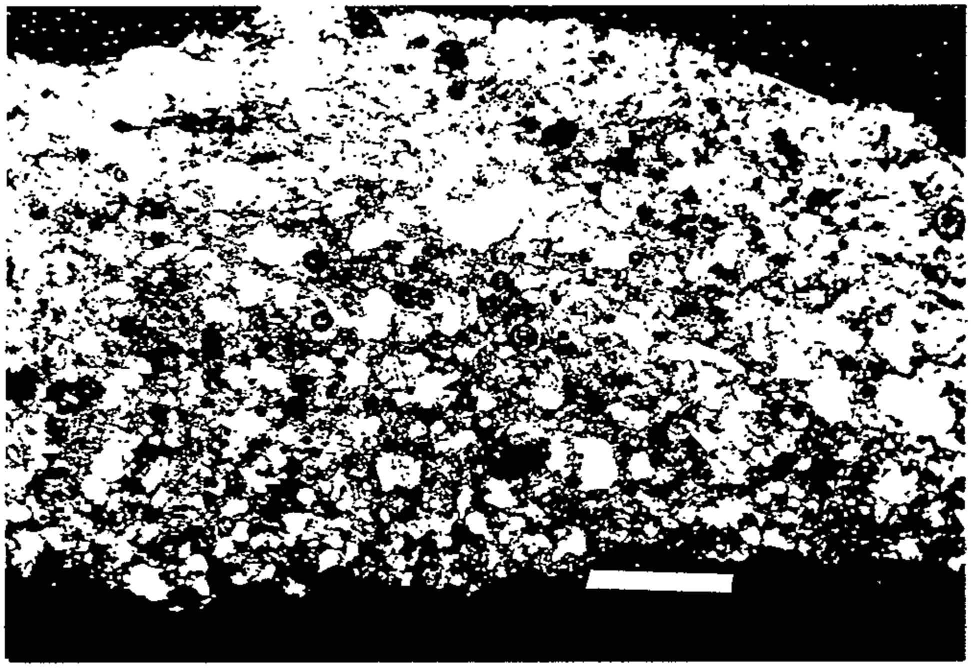


Fig. 5C

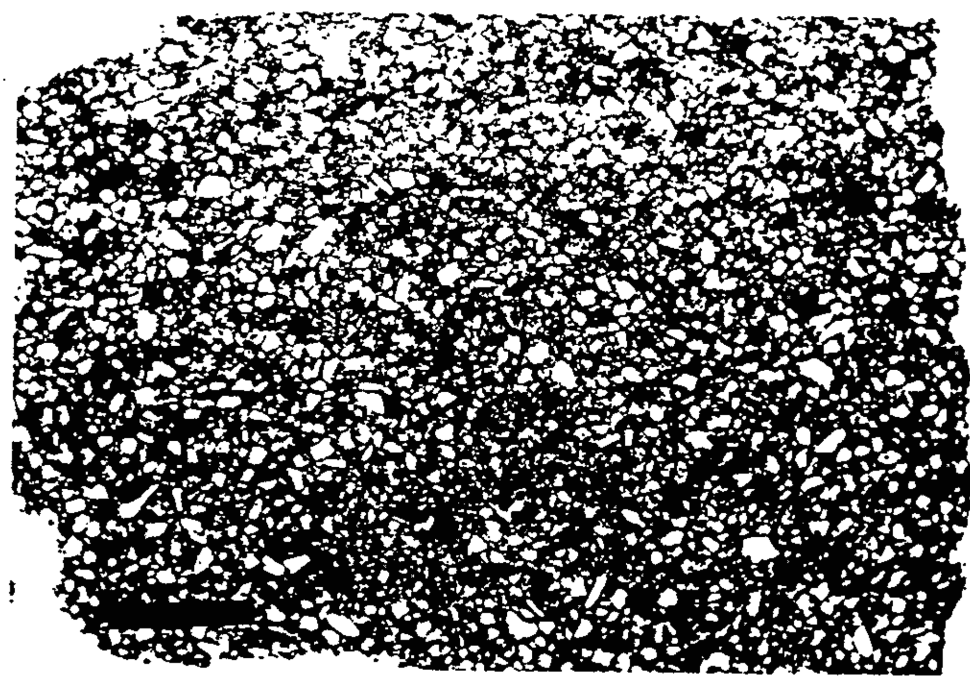


Fig 5D

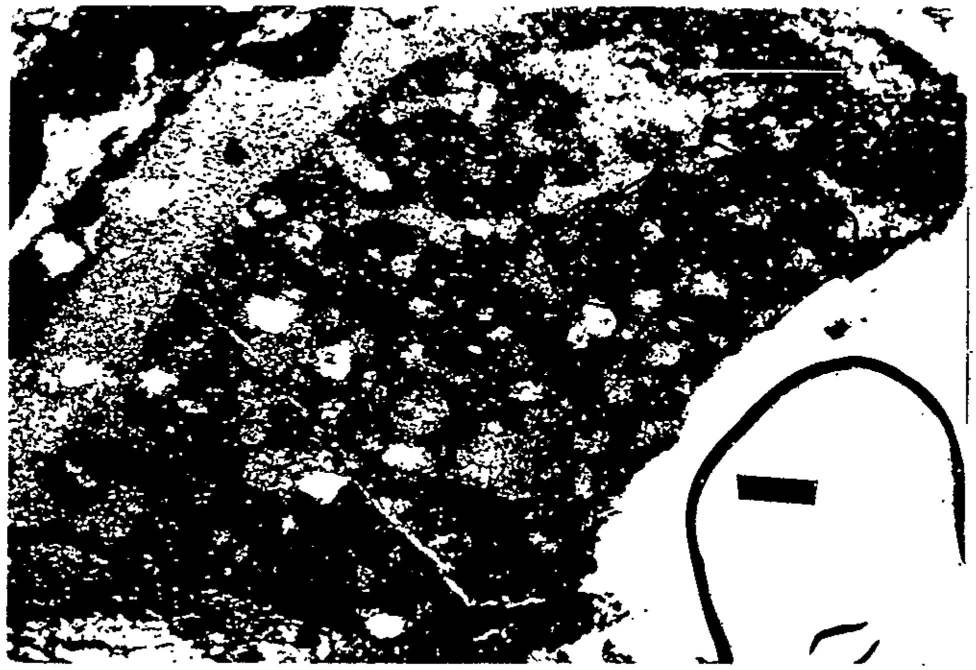


Fig 6A

Fig 6B

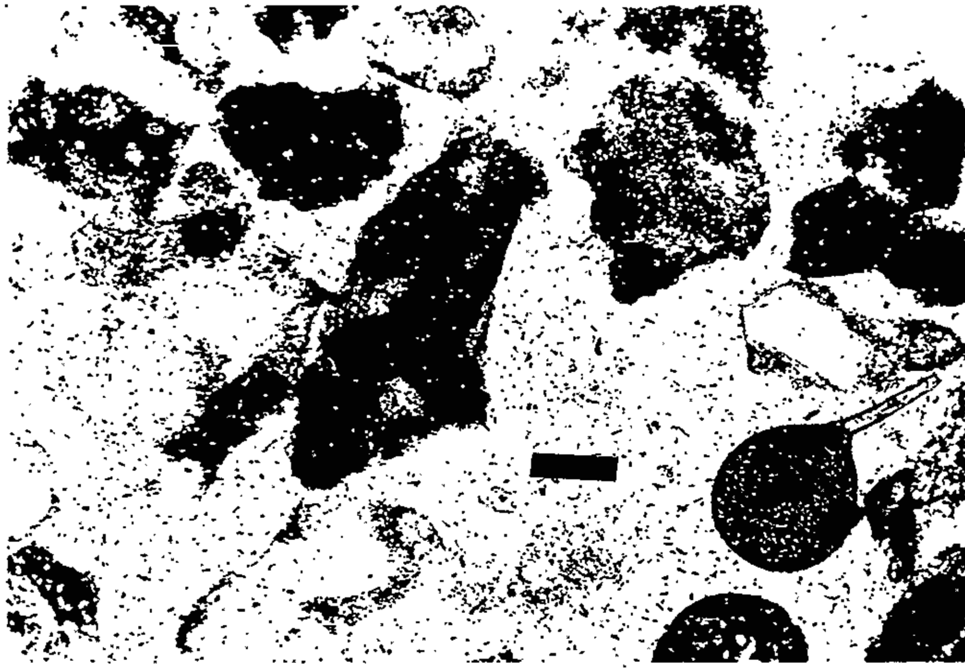


Fig 6C

Fig 6D

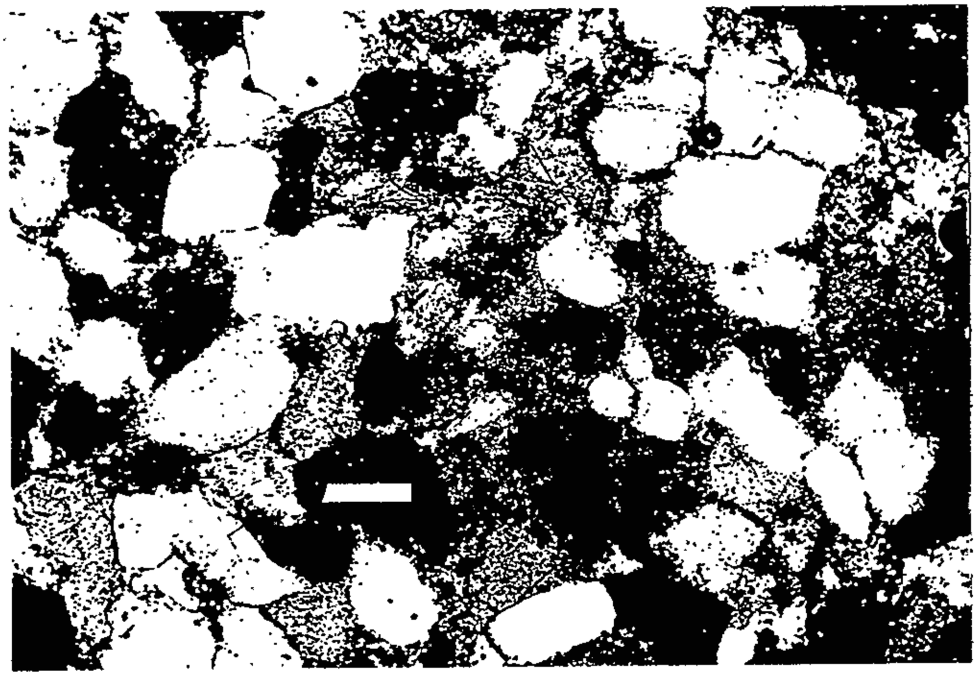


Fig 6 E

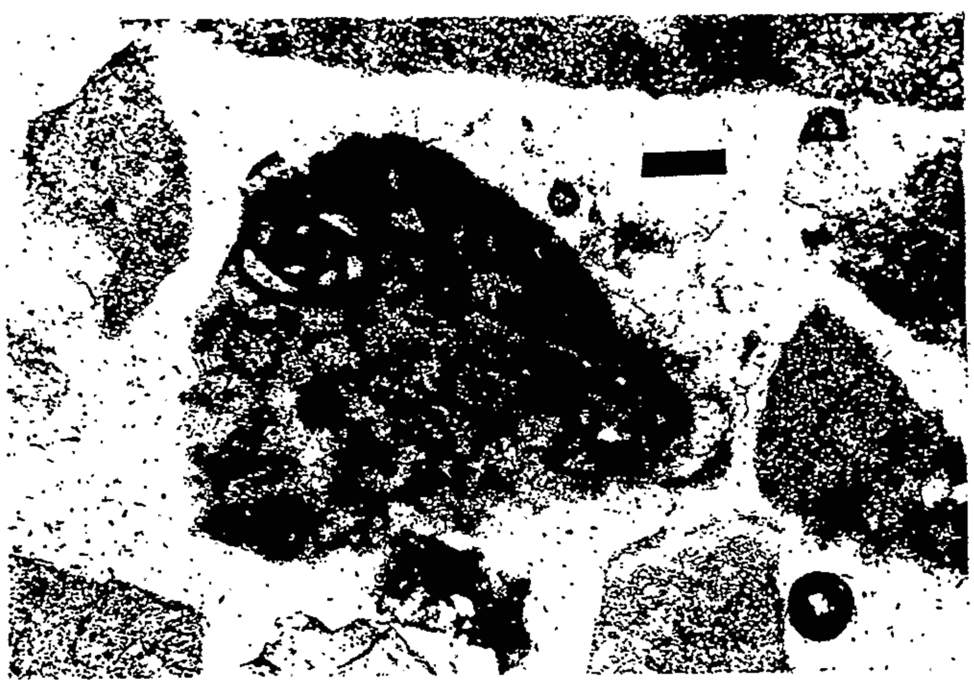


Fig 6 F

Fig 6 G

Fig. 6 H

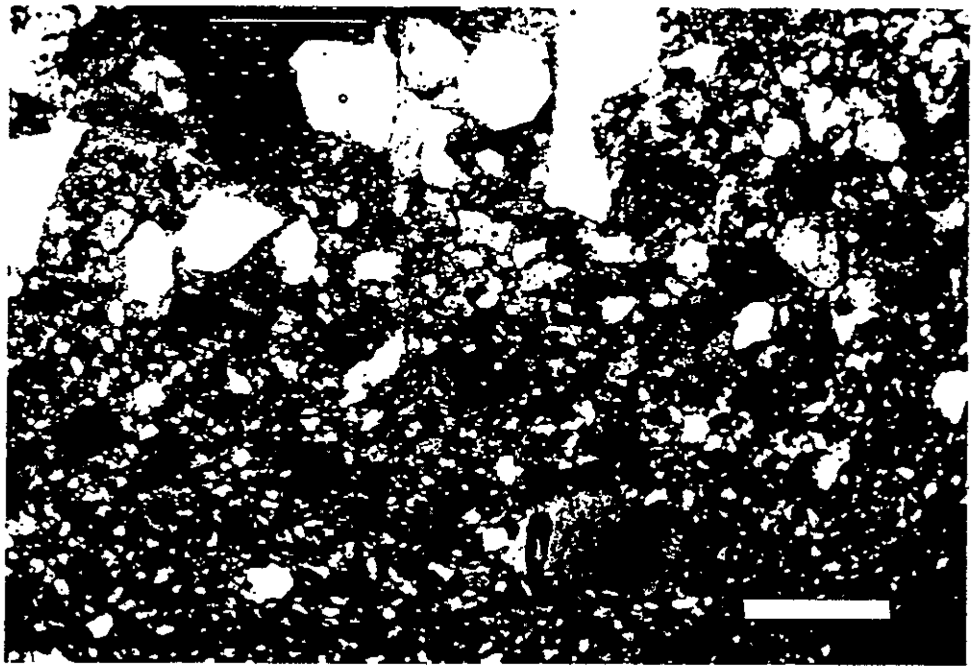


Fig. 7A

Fig. 7B

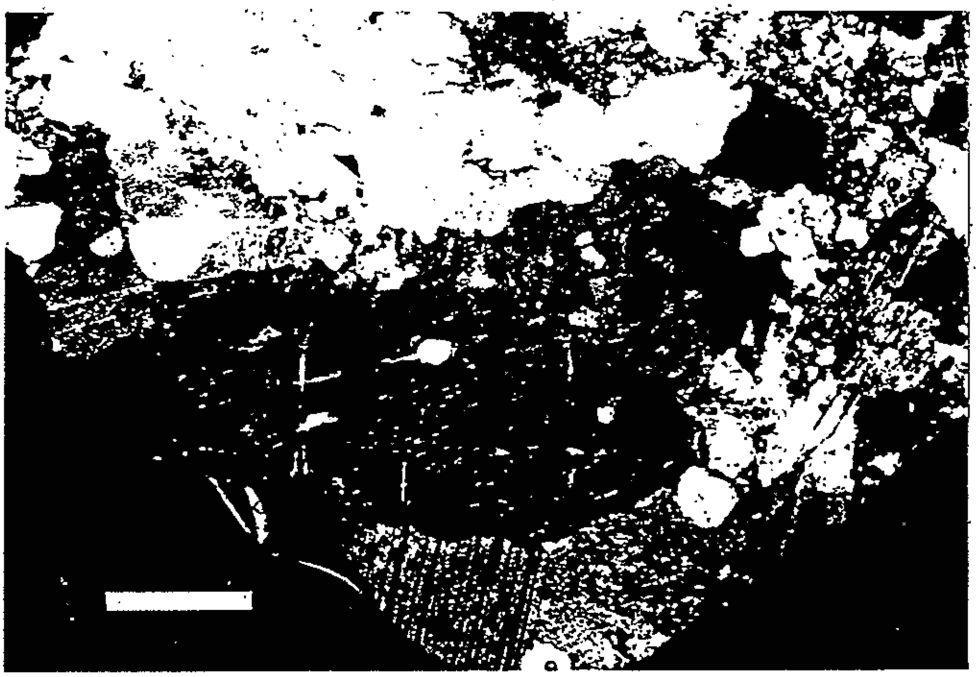


Fig 7C

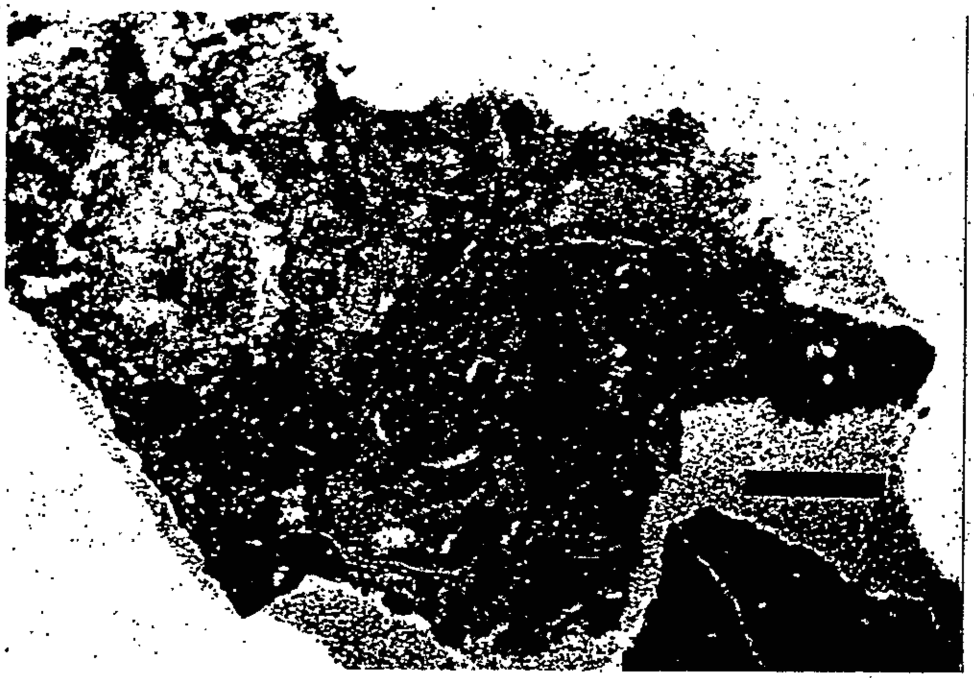


Fig. 8

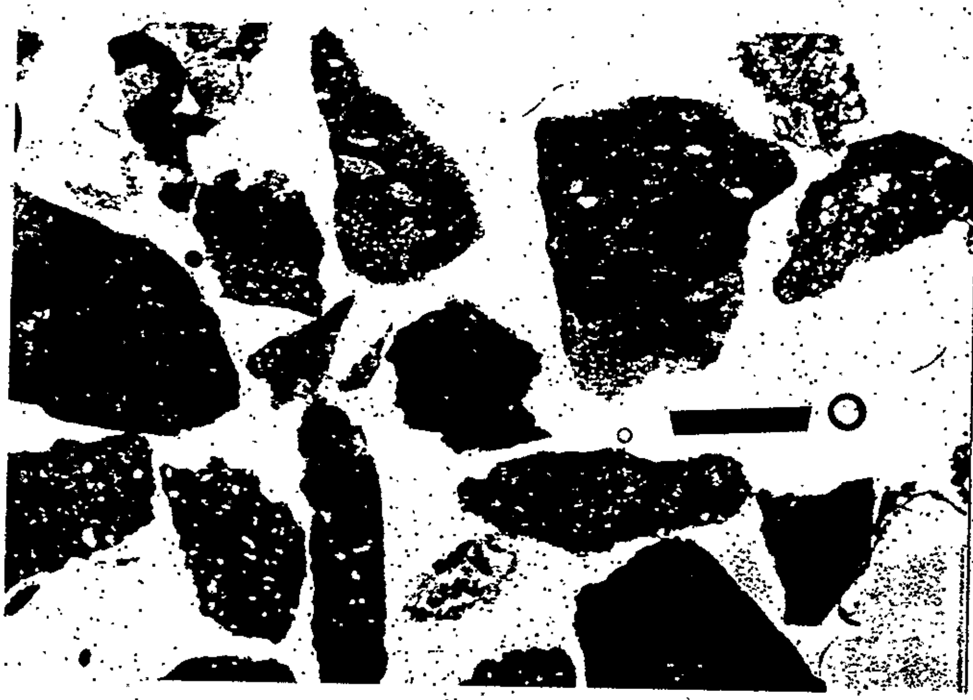


Fig. 9

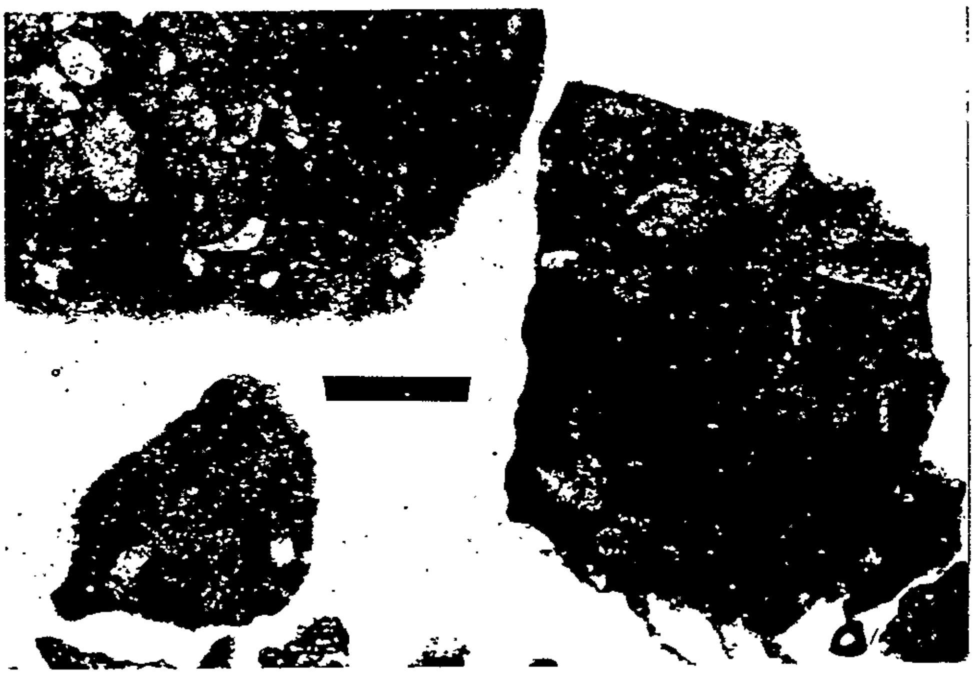


Fig 10

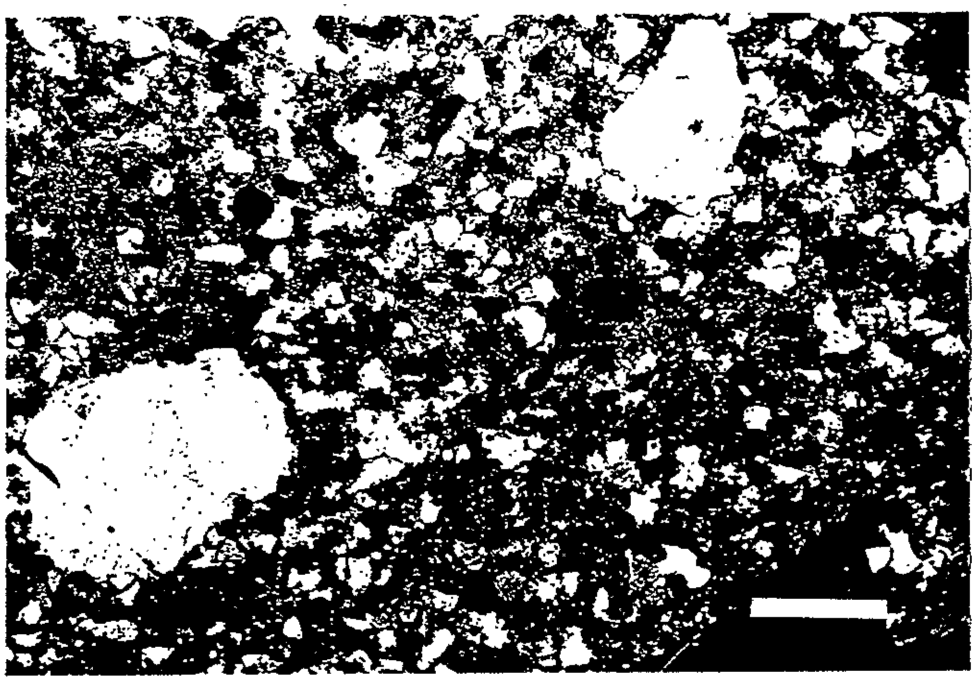


Fig 11.

Appendix A

PETROGRAPHIC DESCRIPTIONS

BISBEE HILLS UNIT #1

(11-26S-11W)

(Number in left column indicates depth at base of 10-ft interval from which the cuttings were taken)

--------tuffs and volcanic arenites (Miocene-Oligocene)----------

300 red-brown claystone, mudstone, silty mudstone

570 red-brown, calcareous, fine-medium grained volcanic arenite (qz, plag, chloritized VRF, CRF, cht)

590 red-brown, calcareous, fine-medium grained volcanic arenite (qz, plag, chloritized VRF, CRF, cht)

720 chloritized volcanic rock, sandy limestone, grainstone and packstone

830 red-brown, medium sandy neospar (very angular qz, plag); one fragment contains calcispheres and phosphatic allochems in partly silicified matrix

960 altered andesite (plag and hbld phenos and microphenos)

1050 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot)

1110 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot)

1140 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot), argillaceous, fn-med

1150 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot) med; also crs silty mudst, fn calcar-argillaceous ss

1160 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot) med; also crs silty mudst, fn calcar-argillaceous ss

1200 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot) med; also crs silty mudst, fn calcar-argillaceous ss, more hbld and few w/chl

1300 red-brown andes VRF w/oxidiz hbld phenos, plag; med vol arenite; chl

1400 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot)

1510 hbld andesite (oxidized outlines of hbld phenos)

1600 red-brown med calcar vol arenite (plag, hbld andes VRF, mt)

1660 hbld andesite (oxidized outlines of hbld phenos), red-brown med calcar vol arenite (plag, hbld andes VRF, mt)

1700 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot)

1800 red-brown, med-crs, calcar volcanic arenite (hbld, oxidized andes VRF, plag, minor biot) med; also crs silty mudst, fn calcar-argillaceous ss

1810 red-brown, fn-med vol arenite; also silty mudst (oxidiz-chloritized hbld andesite, plag, minor qz)

1830 red-brown, calcar, fn vol arenite; argillaceous med ss; some crs siltst (plag, hbld, minor qz, sml VRF, mt)

1930 oxidiz hbld andesite, spic wackest, vfn vol arenite, calcar w/qz, silty lime mudst

1990 similar 1930 w/much less VRF, more wackst and lime mdst, some cht and CRF in sand fraction

2000 calcar arkose, silt to 4mm granules (perthite, microcl, qz, cht, CRF, biot, chlorit)

2040 calcar-silic fn ss (qz, cht, CRF); silty ls, cht, neospar

2060 calcar med vol arenite (hbld andes roc frag, plag, qz); crs silt-med ss; few 1mm grains

2070 lime mdst and ooid grainst; cht; med xln dol; wackst (foram ghosts incl Tuberitina; sandy lime mdst (qz, cht, CRF, plag)

2080 packst (tril, ech, pel, brach); silt-sandy lime mdst (qz, cht); andesite VRF

2090 red-brown silty mdst and vfn sandy mdst (plag, qz, biot, CRF, hbld; ang-subang)

2150 silty lm mdst

2170 silty and sandy lm mdst (ang qz, cht, biot, CRF, plag); hbld andesite VRF; fn-med silic ss (qz, minor cht and VRF)

2220 calcar vfn-fn ss (ang-subang qz, CRF, cht, minor plag, mt, few OG gz grains); silty lm mdst, 2 hbld andes VRF

2230 red-brn calcar fn ss (qz, cht, plag, CRF), qz mostly ang, few reworked overgrowth grains

2250

2290 silty lime mdst; calcar vfn-fn ss (qz, plag, cht, CRF, chlorit VRF); few med ss, one andes VRF

2300 silty lm mdst; calcar fn-med ss (qz, k-spar, plag, cht, CRF, few reworked qz OG, few cht to 1mm)

2350 silty lm mdst; calcar fn-med ss (qz, k-spar, plag, cht, CRF, few reworked qz OG, few cht to 1mm) and sand grains incl andes VRF

2420 lm mdst and silty lm mdst; altered rhyolite

2440 porphyritic rhyolite

2550 porphyritic rhyolite, euh qz phenos 0.6-1.1mm) Na-plag phenos. .8x2.0mm, microxln matrix

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2660 rd-brn calcar fn ss and silty lm mdst (ang-subang qz, cht, reworked qz OG, ziron, mt, CRF)

2700 rd-brn calcar fn ss (qz, CRF, cht, plag, rework qz OG) silty lm mdst, calcar siltst, hbld andes VRF

2810 red muddy vfn ss (ang-subang qz, cht, k-feld, CRF)

2900 red muddy vfn ss and sandy mdst (qz, cht, k-feld, plag, CRF)

2950 hbld andesite

2960 red-brn silty mdst (ang qz, plag, VRF cht), anhydrite in 6 grains, minor hbld andes

3000 hbld andesite

3040 lm mdst w/anhydrite; silty mdst; minor hbld andes

3060 silty lm mdst w/anhydrite; lm mdst

3110 silty lm mdst w/anhydrite; lm mdst

3170 silty lm mdst w/anhydrite; lm mdst

3210 altered felsite (tuff?): kaolinized plag laths and interst feld. 10% interst qz, 15% anh chlorite after mafics

3260 felsite, tuff or ss (ang K-feld, plag, biot, minor qz, VRF)

3350 felsite, tuff or ss (ang K-feld, plag, biot, minor qz, VRF) plus calcar fn ss

3370 rd-brn fn-med ss (VRF, cht, qz, mt, anhy, biot, plag, CRF) silty mdst, lm mdst

3420 felsite, tuff or ss (ang K-feld, plag, biot, minor qz, VRF), rd-brn med ss (VRF, kaoliniz ang-subang feld, plag, biot, minor qz) mud matrix

3460 rd-brn med ss (VRF, kaoliniz ang-subang feld, plag, biot, minor qz) mud matrix

3500 rd-brn calcar med ss (VRF, cht, plag, minor qz, CRF)

3550 rd-brn lm mdst, silty lm mdst, calcar vol arenite (plag, qz, CRF)

3570 rd-brn med ss (VRF, kaoliniz ang-subang feld, plag, biot, minor qz) mud matrix plus calcar fn ss w/slightly more VRF, qz, CRF, mt

3600 siliceous-calcar med ss (felsite breccia? tuff?); (plag, kaoliniz k-feld, minor biot, qz)

3640 felsite? (plag, kaoliniz k-feld, interst qz, chloritiz biot, mt, minor carb

3700 siliceous-calcar med ss (felsite breccia? tuff?); (plag, kaoliniz k-feld, minor biot, qz), minor VRF

3750 brn vfn-fn vol arenite (qz, plag, biot, mt, andes VRF) muddy matrix; med vol arenite w-calcite cement and very ang grains

3790 brn fn calcar plag vol arenite similar 3750

3800 vfn like 3790 and vfn sandy mdst

3850 rd-brn calcar vol arenite as above, ang grains; tr of dol, cherty carbonate, "felsite breccia" as above

3870 red mdst -- poor slide --

3900 fn-med vol arenite (plag, VRF, CRF, anhydrite; very ang-ang); silty lm mdst, calcar vfn-fn vol arenite

3910 fn-med vol arenite (plag, VRF, CRF, anhydrite; very ang-ang); silty lm mdst, calcar vfn-fn vol arenite, anhydrite in lm mdst

3930 fn-med vol arenite (plag, VRF, CRF, anhydrite; very ang-ang); silty lm mdst, calcar vfn-fn vol arenite, fn-med vol arenite (plag, VRF, CRF, anhydrite; very ang-ang); silty lm mdst, calcar vfn-fn vol arenite, anhydrite in lm mdst (minor qz in ss)

3960 fn-med vol arenite (plag, VRF, CRF, anhydrite; very ang-ang); silty lm mdst, calcar vfn-fn vol arenite, w/more mt

4030 rd-brn calcar fn vol arenite (ang-subrnd VRF, plag, cht, CRF, anhyd, qz w/rework OG)

4100 rd-brn calcar fn vol arenite (ang-subrnd VRF, plag, cht, CRF, anhyd, qz w/rework OG), plus siltst and silty mdst

4210 fn xln fresh-hbld andesite, dike?; some like 4100

4220 rd-brn vfn-fn calcar vol arenite (very ang-ang plag, biot, VRF, qz, cht, CRF, mt)

4270 fn xln fresh-hbld andesite, dike?; some like 4100

4300 vfn-fn calcar vol arenite (A-va qz, plag, CRF, VRF, biot, cht); lm mdst; silty and vfn sandy neomorph mdst

4360 siliceous-calcar med ss (felsite breccia? tuff?); (plag, kaoliniz k-feld, minor biot, qz), siliceous-calcar med ss (felsite breccia? tuff?); (plag, kaoliniz k-feld, minor biot, qz), minor VRF, (kaoliniz feldspars)

4410 plag and san frags in felsite matrix; like 4360

4430 silty mdst; minor amts of many of above rocks; vfn-fn ss, VA-A anhyd, "felsite breccia "(tuff?)

4500 silty mdst; minor amts of many of above rocks; vfn-fn ss, VA-A anhyd, "felsite breccia "(tuff?)

4560 rd-brn calcar vfn-fn vol arenite (A-VA plag, biot, CRF, mt, qz); rd-brn mdst, silty to sandy mdst, VRF, dol

4600 rd-brn fn-med calcar vol arenite (VRF, plag, biot, CRF, mt, qz); sandy mdst

4650 rd-brn fn-med calcar vol arenite (VRF, plag, biot, CRF, mt, qz); sandy mdst, plus lm mdst, andes VRF, anhyd in ss

4710 rd-brn fn calcar-argillac vol arenite (qz, plag, VRF, biot); silty mdst

4760 rd-brn sh, silty sh, fn-med calcar vol arenite (ang VRF, plag, less qz) mud matrix; one w/anhyd

4810 rd-brn calcar fn vol arenite (VRF, plag, CRF, cht?, mt, qz); med ss (qz, CRF, VRF, cht?)

4900 <u>CGL</u> brn silty sh and mdst, dol, calcar vfn ss (qz, plag, mt), cht neomorph ls, fn ss (poorly sort, SA, SR, CRF, qz, plag, VRF, cht)

4920 <u>CGL</u> mostly neospar and dol, cht; calcar qz ss (rnd grains); silty ls, neomorph paleoz? ls (bry, <u>Nuia</u>, <u>Nuia</u> plus sand)

4940 <u>CGL</u> dol, neomorph fosil ls, silty mdst, cht, minor vol arenite

4944 <u>CGL</u> like 4940 plus calcar med qz ss

5000 <u>CGL</u> dol and cht

5030 <u>CGL</u> fn-med xln dol in brn silty mdst cgl

-------------Fusselman dolomite (Silurian)---------------------

5200 ltgry, med xln dol w/minor interst qz (anh mosaic)

5300 dk gray, fn xln dol w/minor cht, (anh mosaic)

5400 lt gry, med xln dol (anh mosaic)

5500 dk gry, med xln dol w/minor cht zones, (anh mosaic)

-----------------Montoya Fm. (Middle Ordovician)----------

5600 lt gry, fn xln dol w/common cht, (anh mosaic)

5700 lt gry, vfn-fn xln dol, qz-filled fractures

5800 lt gry, vfn-fn xln dol, tr of interst cht, (anh mosaic)

5810 65% fn-xln dol, 35% dolic cht; cherty dol

5900 fn-med xln dol and cht, euh dol rhombs less than 0.03mm in cht, (anh mosaic)

5950 dk gry med xln dol w/minor cht, (anh mosiac)

5970 dk gry med xln dolic ss and sand dol; SR-WR qz 0.15-0.7mm (med-crs)

------------El Paso Fm., Padre Mbr. (Lower Ordovician-----------

6000 fn-med dol and neomorph lm mdst

6070 fn xln dol, lm mdst, neomorph wackst

6120 neomorph lm mdst and wackst, dolic lm mdst and wackst

6150 neomorph wackst (tril, spic, ost, ech, intracl), dol burrous

6200 neomorph lm mdst and wackst; dolic lm mdst; silty-fn sandy lm mdst

6250 lm mdst and dolic lm mdst (tril, ech, spic, minor silt)

-------------El Paso Fm., McKelligon Mbr.---------------------

6300 wackst (<u>Nuia</u>, ech, spic), silty lm mdst and wackest

6310 dolic wackst/packst (<u>Nuia</u>, ech, spic, tril)

6370 neomorph lm mdst and wackst (<u>Nuia</u>), fn xln dol

6400 lm mdst and wackst (<u>Nuia</u>, spic, gast, tril, intracl, ech), some dolic

6420 <u>Nuia</u> grainst; wackst/packst (<u>Nuia</u>, spic, ech), dolic ls

6440 wackst packst (<u>Nuia</u>, tril, ech, spic) partly dolic, stylolites; grainst (intracl, tril, <u>Nuia</u>, gast)

6500 wackst packst (<u>Nuia</u>, tril, ech, spic) partly dolic, stylolites; grainst (intracl, tril, <u>Nuia</u>, gast)

6550 wackst packst (<u>Nuia</u>, tril, ech, spic) partly dolic, stylolites; grainst (intracl, tril, <u>Nuia</u>, gast)

6590 wackst and dolic wackst (ech, spic, intracl, gast, tril, mminor silt)

--------------El Paso Fm., Hitt Canyon Mbr.-------------------

6610 wackst packst (<u>Nuia</u>, tril, ech, spic) partly dolic, stylolites; grainst (intracl, tril, <u>Nuia</u>, gast), w/more dol

6630 dk gry med xln dol; wackst/packst (<u>Nuia</u>, tril, ech, spic, gast)

6640 med xln dol w/some cht repl, stylolites

6660 med xln dol; lm mdst/wackst (spic, ech); silty lm mdst

6680 med xln dol; lm mdst/wackst (spic, ech); silty lm mdst

6720 med xln dol; lm mdst/wackst (spic, ech); silty lm mdst (<u>Nuia</u> in wackst)

6810 med xln dol, slightly silty

6880 fn-med xln dol, some silty, neomorph wackst (<u>Nuia</u>, ech, tril)

----------------Bliss Sandstone (Lower Ordovician)-----------

6940 med xln dol (one w/Nuia), spic wackst, lm mdst, cht, qzt, qtz w/hbld

6950 med xln dol w/Nuia, sandy dol, dolic wackst, neomorph wackst

-----------------rhyolite intrusive------------------------

6986 felsite (rhyolite) fn xln anh mosaic of qz and feld, fn xln muscovite or sericite; kaolinized

-------------------precambrian------------------------------

7000 qzt, muscov schist, k-feld, vermic chl in qzt

7050 fn xln granite, qzt, qz-muscov schist, dk med xln dol

7060 sericitic qzt, py

7100 qz-muscov schist

7130 qz-muscov schist, granite; wackst, dol

7140 qz-muscov schist, granite; wackst, dol plus andes VRF

7160 qz-muscov schist, granite; wackst, dol plus andes VRF

Appendix B

PETROGRAPHIC DESCRIPTIONS

COCKRELL STATE #1 (14-25S-16W)

(Number in left column indicates depth at base of 10-ft interval from which the cuttings were taken)

1800 several types andesitic/basaltic cuttings; oxidized & calcar matrix; vol arenite; mdst

1900 several types andesitic/basaltic cuttings; oxidized & calcar matrix; vol arenite; mdst

2000 several types andesitic/basaltic cuttings; oxidized & calcar matrix; vol arenite; mdst; more fresh-looking VRF, maybe flows or intrusives, all fn xln

2100 several types andesitic/basaltic cuttings; oxidized & calcar matrix; vol arenite; mdst; more fresh-looking VRF, maybe flows or intrusives, all fn xln; tr fn siliceous qz Ss and rhy?)

2400 approx 70% rd-brn mdst, some silty; 30% VRF

2500 rd-brn sh; tr andesitic VRF

2600 rd-brn mdst & sh; minor crs silty calcar mdst

2660 rd-brn calcar clayst

3110 rd-brn clayst & sh; tr silty sh

3200 rd-brn clayst & sh; tr silty sh

3410 calcar med ss; slightly siliceous (SA-R monoxln & polyxln qz, cht, mdst, plag); sandy calcar mdst (VA-SA qz, plag, biot, cht); rd-brn mdst

3420 ss & sandy mdst; calcar med ss; slightly siliceous (SA-R monoxln & polyxln qz, cht, mdst, plag); sandy calcar mdst (VA-SA qz, plag, biot, cht); rd-brn mdst; tr K-feld grains

3500 ss & sandy mdst; calcar med ss; slightly siliceous (SA-R monoxln & polyxln qz, cht, mdst, plag); sandy calcar mdst (VA-SA qz, plag, biot, cht); rd-brn mdst; tr K-feld grains; cht & plag common

3600 rd-brn mdst & sh; some ss like 3410-3500

3700 felsite: microphenos of san, biot in anhedral mosaic of qz, plag, san

3760 rd-brn calcar fn ss (A-SR qz, plag, cht, CRF, minor K-feld); silty mdst

4010 rd-brn calcar fn ss (A-SR qz, plag, cht, CRF, minor K-feld); silty mdst (tr VRF & biot, more cht); abnt sh & mdst

4150 mdst, sh; felsite

4160 siltst, mdst, sh; forams resembling Globigerina (0.03-0.06mm); sml biot? flakes

4170 siliceous med ss (qz, cht, zircon); ss characterized by interlooked overgrowths, interst clay/chl?; mdst; siltst, mdst, sh; forams resembling Globigerina (0.03-0.06mm); sml biot? flakes

4180 siliceous fn-med ss similar 4170; forams like 4160 in mdst & sh

4310 fn ss siliceous fn-med ss similar 4170; forams like 4160 in mdst & sh; med ss w/abnt cht grains and tr glauconite; silty mdst & sh; one VRF or intrusive frag

4330 fn & med siliceous ss similar 4170-4310 fn calcar ss & siltst

4350 fn ss similar 4330; minor mdst & calcar fn ss

4370 fn & med siliceous ss similar 4170-4350; glauconite abnt in muddy ss; some sh & mdst; tr plag & K-feld

4380 fn & med ss similar 4370; some calcar fn ss & sandy mdst & sh

4440 fn & med ss similar 4380; minor med ss w/VRF, abnt cht, plag; one cutting of calcar sandy mdst w/abnt pyrite

4460 similar 4440 w/more sh

4520 rhyolite

4600 rhyolite

4700 rhyolite

4870 fn siliceous-argillaceous ss

4880 fn & med siliceous ss w/interlooking overgrowths; calcar-agrillac fn ss

5010 fn & med siliceous ss (qz w/tr cht), minor calcar & clay matrix

5020 fn & med siliceous ss (qz w/tr cht), minor calcar & clay matrix

5160 rhyolite

5200 rhyolite

5270 calcar fn ss (qz); argilac fn ss; fn-med siliceous ss (qz, tr cht & zircon); mdst & silty mdst

5280 calcar fn ss (qz); argilac fn ss; fn-med siliceous ss (qz, tr cht & zircon); mdst & silty mdst w/tr andes VRF

5400 siliceous crs siltst-vfn ss (qz w/interlock OG); minor calcar fn ss & tr VRF cuttings

5420 rhyolite

5580 rhyolite

5600 silicous crs siltst-vfn ss (qz w/interlock OG, clay to chl)

5790 argilac crs siltst (VA-A qz, minor cht, pyrite common); some mdst & silty mdst

5800 argilac crs siltst (tr plag); altered felsite intrusive

5900 rhyolite

5950 rhyolite

6130 rhyolite

6320 rhyolite; microphenos of san & biot in felty mosaic of san & plag laths w/minor interst qz

6330 rhyolite

6520 calcar vfn ss (VA-SR qz, cht CRF) poorly sorted w/few crs ss size grains; some silty mdst

6530 rhyolite

6650 rhyolite

6670 rhyolite

6680 rhyolite

6700 rhyolite

6800 calcar crs siltst (VA-SR qz, cht, plag); minor silty lm mdst & calcar sh

6850 calcar crs siltst-med ss (poorly sorted VA-SA qz, cht, plag, K-feld, CRF), some qz w/reworked OG; tr silty lm mdst

7020 calcar med-crs ss, few 2mm grains (qz, plag, K-feld, sh, CRF); altered felsite intrusive, silty lm mdst

7110 rd-brn calcar crs siltst-med ss (qz, plag, K-feld, CRF); silty dolic lm mdst w/few bioclast ghosts

7120 similar 7020 & 7110; mixed lithologies

7130 similar 7120; mollusc frags in some muddy siltst; lge (1-1.5 mm) ang K-feld common

7140 similar 7130; predom rd-brn

7230 similar 7120; mixed lithologies; (some polyxln qz to 1.0 mm)

Appendix C

PETROGRAPHIC DESCRIPTIONS

SALTYS UNIT #1 (33-25S-15W)

(Number in left column indicates depth at base of 10-ft interval from which the cuttings were taken)

Oligocene volcanic rocks

170 largely devitrified vitric ash-flow tuff; abundant large shards flattened shards, few spherulites, minor biotite, sanidine crystal fragments

280 spherulitic, vitric ash-flow tuff; abundant large shards, scarce biotite, quartz, sanidine crystal fragments; not like #170

760 poorly sorted, angular quartz grains in calcareous muddy matrix; limestone with echinoderms and brachiopods; andesite, calcareous chert, spar calcite, veined limestone, meta quartz, chalcedony, lime mudstone; poorly sorted quartz sandstone

770 silica-cemented,poorly sorted, rounded to subangular quartz in medium sandstone (Mojado); some thin overgrowths; sandy limestone, lime mudstone-wackestone with echinoderm and brachiopod fragments

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Fault zone (no cuttings)

1010 lime mudstone, peloidal wackestone(one fragment), spar calcite

1020 lime mudstone, spar veins, spar calcite very abundant, silty limestone

1030 spar calcite, lime mudstone, silty limestone; bryozoan fragment?

<u>Earp Fm (Wolfcampain)</u>

1050 peloids, forams (<u>Tuberitina</u>?), ostracods, echinoderms, encrusting forams (<u>Tubiphytes</u>?), bracbiopods?, phylloid algae?; wackestone, packstone, lime mudstone

1140 lime mudstone, calcareous siltstone, neosparite; dolomite?; fractured

1210 calcareous very fine sandstone

1230 calcareous very fine sandstone, siltstone, lime mudstone

1370 lime mudstone, calcareous siltstone

1470 lime mudstone, calcareous siltstone

1530 lime mudstone, siltstone

1620 lime mudstone, siltstone

1680 calcareous siltstone, mudstone, foram wackestone

1710 forams, peloids, echinoderms, bryozoa?; grainstone, wackestone, silty limestone, calcareous very fine sandstone

1750 mudstone, siltstone; echinoderms, forams,

1760 silty limestone, mudstone

1790 forams, bryozoa, echinoderms, silty limestone, mudstone, wackestone

1800 echinoderms, forams, ostracods, bryozoa, encrusting forams, echinoid spine; packestone, grainstone, silty limestone

1850 echinoderms, brachiopods, forams (including Climacammina?); mudstone, siltstone, minor wackestone

1900 trilobites, ostracods, forams (including Globivalvulina?), echinoderms, gastropods; organic-rich matrix; neosparites (wackestone), silty limestone, calcareous siltstone, mudstone; pyrite in calcareous very fine sandstone

1920 fresh plagioclase, biotite and magnetite; interstices filled with carbonate ---- dacite(?) dike

1950 calcareous siltstone, mudstone, very fine sandstone, lime mudstone, neosparite (wackestone, packstone); globular forams

2000 micritized forams (including Globivalvulina?), echinoderms, bryozoa; calcareous siltstone, mudstone, neosparite

2150 chert, calcareous chert, siltstone, mudstone, calcareous very fine sandstone, microsparite; abundant iron-oxides and pyrite in some fragments; no fossils

Horquilla Fm (Pennsylvanian - Wolfcampian?)

2160 bryozoa, echinoderms, trilobites; silty limestone, microsparite, neosparite, chert, calcareous chert, calcareous very fine sandstone, lime mudstone, wackestone

2200 abundant echinoderms, bryozoa, brachiopods?, conodont; chert, calcareous chert, neosparite, silty limestone, mudstone, packstone

2220 conodont, bryozoa; silty limestone, neomorphosed micrite, calcareous very fine sandstone, calcareous chert

2250 bryozoa, echinoderms, brachiopods?, abundant small fossil fragments; micrite with stromatactis?, chert, calcareous chert, neosparite, silty limestone, calcareous mudstone

2300 bryozoa, foram fragments; chert, calcareous chert, neosparite, silty limestone

2320 brachiopods, bryozoa, coral?; dolomitic limestone, neosparite, silty limestone, chert, calcareous chert

2350 fusulinid, bryozoa, brachiopods, fragments of forams, including fusulinids; neosparite, chert, silty limestone, calcareous chert

2400 possible fusulinid--badly neomorphosed; similar to 2450 except fewer allochems; all limestone is microspar

2450 limestone with very small fossil fragments:echinoderms, brachiopods, forams; microspar; silty to very fine sandy limestone; chert, calcareous chert, calcareous siltstone

2470 echinoderms and unident, fossil fragments; lime mudstone and wackestone, neomorphosed; chert, calcareous chert

2490 echinoderms and allochems as in several samples above; neosparite, chert, calcareous chert, silty limestone

2530 crinoids, brachiopods, conodont; neosparite, crinoid grainstone, packstone, chert, calcareous chert

Paradise Formation (Mississippian)

2600 coarse siltstone, calcareous coarse siltstone, neosparite, chert, micrite; no identified fossils

2610 siltstone, coarse siltstone, silty micrite, shale, siliceous very fine sandstone; oolite, biopackstone; ooids less than 0.15 mm; bryozoa, echinoderms with micritized rims, spicules?

2620 ooid sparite, biopackstone, biograinstone, silty black mudstone; coral, echinoderms (echinoid), bryozoa, crinoid

2670 ooid grainstone (ooids about .8 mm), very fine sandstone, silty neosparite, silty mudstone; bryozoa, crinoids, algae (Girvanella?), Endothyrids, brachiopods, conodonts, pellets?

2720 oolite, silty biopackstone, silty micrite, chert; Endothyra or primitive fusulinid, bryozoa, crinoids, brachiopods, peloids, and pellets?

2740 siltstone, muddy siltstone, calcareous siltstone, lime mudstone; trace of oolite, packstone, grainstone as above

Escabrosa Group (Mississippian)--Hachita Fm

2780 crinoid grainstone, siltstone; bryozoa

2800 crinoid grainstone

2850 crinoid grainstone, silty lime mudstone, biopackstone

2900 crinoid grainstone, chert, silty lime mudstone

2950 crinoid grainstone, trace of chert and siltstone

3000 calcareous chert, crinoid grainstone, silty lime mudstone; byrozoa neosparite

3050 crinoid grainstone, silty lime mudstone; bryozoa

3100 crinoid grainstone, packstone, silty lime mudstone; bryozoa, pellets?

3150 crinoid grainstone, packstone, trace chert; bryozoa

Escabrosa Group (Mississippian)--Keating Fm

3260 peloidal grainstone; bryozoa, crinoids, ostracod?, brachiopods?

3290 similar to 3260 with chert

3350 fine-grained intrusive rock (altered)--maybe andesite or latite; minor spar, silty neosparite; crinoids

3370 peloidal microsparite, dolomitic chert; spar calcite and crinoids; altered intrusive rock

3400 peloidal microsparite; minor spar calcite

3450 silty microsparite--packstone, peloidal microsparite; mostly triturated allochems; abundant silt in all lithologies

Percha Shale (Devonian)

3500 silty lime mudstone; trace of echinoderm fragments

3550 silty lime mudstone; trace of echinoderm grainstone (cave?)

3600 silty lime mudstone

3620 altered intrusive rock (maybe dacite or latite); silty lime mudstone

3670 altered intrusive rock as above: predominantly plagioclase laths, secondary calcite and quartz, some clay and pyrite; silty lime mudstone

3760 altered intrusive rock as above

Montoya Frm. (Middle Ordovician) Cutter Mbr.

3830 fine to medium crystalline dolomite, cherty dolomite, dolomitic chert

3880 very fine crystalline dolomite and minor dolomitic chert

3910 microsparite; chert and dolomite as above

3930 altered intrusive rock as in Percha Shale (plagioclase, calcite, silica); microsparite (lime mudstone), chert, dolomite as above

Montoya Frm. (Middle Ordovician) Aleman Mbr.

4000 fine crystalline dolomite and abundant dolomitic chert

4050 very fine to fine crystalline dolomite and abundant dolomitic chert

Montoya Frm. (Middle Ordovician) Upham Mbr.

4100 fine to medium crystalline dolomite and minor chert

4120 fine crystalline dolomite

Fault with lower El Paso Frm Ordovician) Hitt Canyon Mbr below

4270 fine to medium crystalline dolomite

4300 fine crystalline dolomite, minor chert, possible echinoderm ghost

4310 very fine crystalline dolomite, minor chert and chalcedony; chalcedony possibly replacing brachiopod?

4360 fFine to medium crystalline dolomite, chert, minor chalcedony

4400 medium crystalline dolomite, dolomitic chert

4460 medium crystalline dolomite, dolomitic fine to medium sandstone; echinoderms, Nuia packstone

4480 medium crystalline dolomite, dolomitic medium sandstone or sandy dolomite; echinoderms, Nuia packstone

4490 medium sandy dolomite, medium crystalline dolomite, trace of silica-cemented sandstone; Nuia packstone, echinoderms, peloids

4480B (40-ft depth correction) Nuia packstone, poorly sorted siliceous and dolomitic sandstone, chert, minor dolomite

Bliss Sandstone (Upper Cambrian? to Lower Ordovician)

4490B fine silica-cemented poorly sorted sandstone, sandy dolomite, peloidal lime mudstone

4500B fine to medium sandstone; minor lime mudstone and chert

4520 fine to medium sandstone; minor lime mudstone and silty mudstone

4530 fine to medium sandstone; muddy siltstone; minor silty dolomite and packstone

4540 fine to medium sandstone, dolomitic sandstone, dolomitic chert, medium crystalline dolomite, silty mudstone

4550 silty mudstone, fine to medium sandstone, dolomitic chert, <u>Nuia</u> packstone (cave?)

4580 silty mudstone, fine sandstone, medium crystalline dolomite, packstone

4600 fine to medium to coarse sandstone (arkose:microcline), silty mudstone, mudstone

4650 muddy siltstone, fine to medium sandstone (arkose)

4670 muddy siltstone, medium to coarse sandstone (arkose), some quartz to 5 mm; mudstone, limestone, dolomite, cherty dolomite

4700 neosparite, trace of silty peloidal wackestone, muddy siltstone, mudstone, minor fine to medium dolomitic and siliceous sandstone (arkose); trace intrusive andesite? (cave?)

<u>Fault zone: rocks below are similar lithology but much more sericitic and dynamically formed: Probable Ringbone Formation (Upper Cretaceous)</u>

4720 similar to 4700 but no andesite, no peloidal wackestone; minor sericite claystones

4750 silty mudstone, muddy fine sandstone, minor siliceous medium sandstone, peloidal silty packstone, dolomitic chert, silty dolomite; sericite common in mud, many rock types stretched and granulated

4760 poorly sorted, muddy, red-brown sericitic fine sandstone; silty, sericitic mudstone. Monocrystal and polycrystal quartz, minor chert, k-feldspar, plagioclasevery angular to subangular grains. Dolomite and andesite (cave?)

4800 hematitic mudstone, silty mudstone, minor very fine sandstone; abundant sericite and minor detrital biotite; trace of peloidal limestone, dolomite, and andesite (cave?)

4850 hematitic mudstone, minor silty mudstone, sandstone vfn (VA-SA qz, cht; reworked OG on qz); tr detrital biotite and plagioclase

4900 poorly sorted, muddy pale brown fine sandstone; very angular to subround grains include chert, CRF, biot, feldspars, quartz; abundant sericitic mudstone, deformed fabrics; not as much hematite

4930 red-brown, calcar fine sandstone (VA-A qz, cht); fine-medium calcareous sandstone (VA-SR qz, plag, K-feld, CRF): arkose-arkosic sed litharenite w/few andes VRF

4950 red-brown fine-medium sandstone; poorly sorted, well rounded to sub-angular grains include many chert, feldspar (perthite, plagioclase) grains; lots of clay (kaolin?) possibly few carbonate grains; sericitic shale, mudstone and silty mudstone; few like 4930

5000 coarse siltstone to fine sandstone (VA-SA qz, plag), abundant chert grains, tr K-feld & VRF), muddy matrix; sericite common; possible chlorite

5020 similar to 5000; silica cement abundant in fine-medium sandstone; minor calcite cement in silty mudstone; sericite common; possible chlorite

5050 red-brown muddy, coarse siltstone and very fine-medium sandstone with minor VRF & CRF, some plag & K-feld, abundant chert grains; very angular to subrounded grains; silty mudstone; minor sericitic rocks; rocks appear less deformed

5100 similar to 5050 with abundant relatively fresh plagioclase grains in sandstone; some chert and K-feldspar grains to 1.0 mm in calcareous sandstone

5150 muddy, very fine to fine sandstone, silty mudstone, mudstone (hematitic). (SA-R Quartz, chert, plagioclase, K-feldspar; trace biotite, magnetite, CRF?, tr VRF; sulfides). Deformed fabric in fine grained rocks; chlorite in matrix

5190 similar to 5150; minor limestone, oolitic limestone, microspar (cave?)

5200 red-brown very fine to fine, muddy, calcar sandstone, siltstone, silty mudstone, mudstone (quartz, chert, plagioclase, K-feldspar: very angular to sub rounded grains)

5270 red-brown very fine-fine argillaceous sandstone (very angular to subangular grains of qtz, cht?, felsite VRF, plag, k-feld, biot, chlorite)

5350 red-brown very fine to fine argillac sandstone; (very ang. to subrounded qtz, cht?, felsite VRF, plag, k-feld, biot, muscovite(?); minor pyrite

5380 hornblende andesite porphyry (relatively fresh): plagioclase phenocrysts in holocrystalline, intergranular matrix of plag laths, pyroxene, hornblende, biotite, and magnetite granules

5500 red-brown silty mudstone; minor muddy calcareous siltstone (qtz, cht?, plag, k-feld, felsite VRF)

5550 very fine to fine calcareous and siliceous sandstone, siltstone, mudstone interbedded and interlaminated; (SA-R qtz, and minor cht, plag, k-feld, biot, VRFs(?), qtz overgrowths)

5600 latite(?); plag laths, minor interstitial quartz; pyroxene-hornblende(?)-biotite granules mostly replaced by chlorite

5680 mixed lithologies: fine crystalline latite or andesite very altered and replaced by carbonate; very fine to fine calcareous sandstone; (VA-SR qtz, cht?, plag, biot, felsite VRF?, carbonate rock fragments CRF)

5800 red-brown silty mudstone, muddy siltstone, calcareous very fine Ss similar 5550 & 5680; (qtz, biot, plag, cht? CRF). cht & CRF-appearing grains may be (probably are) felsite VRF's.

5810 red-brown silty mudstone, shale calcar vfn-fn sandstone similar 5800; Globigerina-like forams (0.03-0.14mm) in sandy mdst

5820 red-brown silty mdst & shale; abnt forams like 5810; few Inocernmus? prisms & mollusc frags

5830 red-brown silty shale and muddy limestone; abundant Globigerina cretacae(?), minor Inoceramus? prisms; qtz, plag, VRF, biot; thinly laminated

5850 similar 5810-5830

5860 similar 5810-5850; plag & biot in sand fraction

5870 similar 5860

5900 mixed lithologies: fine crystalline latite or andesite, altered with much chlorite, pyrite, calcite; and fine-medium calcareous arkosic Ss with muddy matrix (biot, qtz, cht, plag); tr foram shale and siliceous sandstone

6000 fine to medium sandstone, minor chert, no feldspar; silica cement; subang to well rounded grains with OG; (cave? of Globigerina ls and latite)

6110 very fine to fine argillac, calcar Ss; minor chert, plag, biot; minor silica cement; very ang to sub rounded grains; minor Globigerina silty limestone (Cave?)

6270 fine to medium siliceous & argillac Ss; minor cht, k-feld w/clay alteration; pyrite in muddy seams; subround to well round grains

6340 fine to medium siliceous & argillac Ss: qtz overgrowth cement; (well round grains qtz, w/tr of cht, CRF; well sorted; and very fine Ss: qtz overgrowth cement, round to well round grains, qtz, cht, CRF more abundant, well sorted; and silty mudstone with few qtz grains to 1 mm

6400 very fine-fine sandstone: like 6340; also clayey crs siltstone (qtz, cht, glauconite CRF) calcite and chlorite cement: trace of andesite

6450 fine-med Ss: like 6340 and 6400; minor spar calcite cement, trace of plag; very fine argillac Ss: trace of plag grains

6500 very fine Ss: qtz overgrowth cement, also calcite, chlorite; qtz, cht, CRF; clayey coarse siltstone: very ang to subround qtz, cht, CRF; silty mudstone

6510 similar 6500 plus fine-med Ss: qtz overgrowth cement on well rounded qtz

6600 very fine Ss: minor qtz overgrowth, calcite, clay cement; very ang to subrnd grains of qtz, cht, few CRF and bivalve fragments

6650 very fine Ss: like 6600; very fine sandy neosparite; silty mudstone; dolomitic chert; bivalve and gastropod(?) fragments

6730 small cuttings include: med qtz Ss, very fine Ss, muddy siltstone, silty mudstone, qtz, cht, CRF grains

6810 fine-medium Ss; silica cemented with intergrown overgrowths; trace of plag, cht, CRF; calcareous very fine Ss: cht and CRF common as subang to rnd grains; silty

6940 coarse siltstone to very fine Ss: qtz, cht, CRF; andesite: plag, hornblende, magnetite; attached spar calcite (vesicle or clast?); silty mudstone

7000 fine Ss: calcareous, few qtz overgrowths: qtz, cht, few CRF; muddy, poorly sorted very fine Ss, organic rich; calcareous coarse siltstone; silty mudstone; very fine to fine siliceous Ss: qtz, cht, few CRF

7070 silty mudstone; muddy siltstone; minor silty lime mudstone; VRF (several types of andesite fragments); organic rich

7100 muddy coarse siltstone; muddy very fine Ss: qtz, cht, CRF; calcareous very fine sandstone: qtz, cht, CRF, silty lime mudstone

7130 calcareous very fine Ss and coarse siltstone: very ang to sub rnd qtz, cht, plag, biot, CRF; silty lime mudstone; laminated

7150 calcareous medium Ss: qtz overgrowths, qtz, cht, CRF, K-feld; calcareous very fine Ss and coarse siltstone (some well sorted); silty mudstone and lime mudstone fragments (maybe Orbitolina?)

7200 very fine Ss, siltstone, silty mudstone as 7150; CRF to 1 mm in siltstone

7210 muddy coarse siltstone, very ang to sub ang qtz; calcareous coarse siltstone, very ang to sub ang qtz

7300 silty mudstone, very ang to sub ang, med-coarse siltstone; one qtz grain to 1.8 mm; slightly silty neomorphosed micrite; fine Ss with cht and CRF

7310 muddy (mostly clay) coarse siltstone; very ang to sub ang qtz and minor CRF; calcareous very fine Ss: very ang to sub ang qtz and rnd CRF

7390 very fine calcareous Ss and coarse siltstone: very ang to sub rnd qtz, cht, CRF; very fine silica cemented Ss with same content; silty lime mudstone

7440 similar--some very poorly sorted medium calcareous Ss with very ang to sub ang qtz to .5 mm; very abundant cht and CRF

7500 some calcar-siliceous coarse Ss: qtz, cht, K-feld (subarkose); silty mudstone, lime mudstone, andesite, calcareous coarse' siltstone

7580 forams (.2 - .3 mm), Orbitolina, ostracod, gastropod, thick shelled bivalves; spar calcite; silty neomorphosed foram wackestone; poorly sorted muddy coarse siltstone with CRF

7590 similar; ostracod, echinoderm; 3 mm neomorphosed wackestone clast in darker wackestone

7600 medium Ss: calcite and sericite cement; silty neosparite, foram wackestone; muddy siltstone

7650 coarse siltstone; very fine Ss; fine Ss: calcareous, qtz, cht, CRF; muddy siltstone with abundant pyrite

7660 similar to 7650 and lime mudstone; bivalve fragments in siltstones; one andesite porphyry fragment

7700 muddy coarse siltstone and silty neosparite; qtz, plag, CRF; abundant bivalve fragments; echinoderm? and ostracod

7720 coarse Ss: chlorite-sericite organic-rich matrix: polycrystalline (plutonic) qtz, plag, perthitic microcline: arkose with ang to sub ang grains

____________intrusive sill or dike in Ringbone Fm.____________

7780 much altered, fine-crystalline igneous rock (andesite?); foram wackestone; muddy siltstone and fine to medium Ss: qtz, plag, perthite; chlorite-sericite matrix ang to sub ang grains; interlaminated lithologies

7800 fine crystalline diorite: intensely argillized plagioclase, abundant chlorite in interstices; hornblende, biotite, magnetite, pyrite, apatite

7850 same

7950 same (.2 - 1 mm hornblende, .1 - .5 mm biot, .1 -1 mm plag)

8000 fine crystalline diorite: plagioclase (oligoclase-andesine), hornblende, biotite, apatite, magnetite; plagioclase altered to clays; abundant chlorite

8120 coarse sandstone: chlorite-sericite matrix; polycrystalline qtz, perthitic k-feldspar, cht -- arkose

8150 coarse arkose Ss: like 8120: perthite, microcline, spicular cht in the sand

8300 cht, microcline, plutonic qtz, grains; very fine siliceous Ss: qtz overgrowths, qtz, k-feld, CRF, cht sub ang to rnd grains; diorite (cave?), trace of dolomite

8330 diorite, silty lime mudstone, muddy coarse siltstone, chert

8340 chert (some spicular) with trace amounts of dolomite (some silty), siltstone, andesite -diorite

Probable Fusselman Dolomite

8350 fine crystalline dolomite, lime mudstone, fine sandy mudstone; laminated muddy siltstone with biot flakes; silica cemented fine Ss; cht

8360 fine crystalline dolomite (possible ghosts of anhydrite?); calcareous coarse siltstone with CRF; sandy mudstone, lime mudstone partly dolomitized

8370 fine crystalline dolomite; neomorphosed lime mudstone-wackestone

8500 medium crystalline dolomite (anhedral) to coarse crystalline dolomite (anhedral)

8600 medium crystalline dolomite (anhedral), slightly calcitic

Cutter Mbr. of Montoya Fm.

8640 spicular chert; fine crystalline dolomite, slightly calcitic

8650 fine and medium crystalline dolomite, slightly calcitic

8660 fine crystalline dolomite: anhedral, equat, uniform size crystals; few unidentifiable fossil ghosts

8760 fine and medium crystalline dolomite, slightly clacitic

8790 fine crystalline dolomite, slightly calcitic

8810 very fine crystalline dolomite: anhedral, equant, uniform size crystals; some chert

______________Aleman Mbr., Montoya Fm.______________

8850 fine and medium crystalline dolomite; dolomitic spicular chert; chert-filled burrows in dolomite

____________Cable Canyon Mbr., Montoya Fm.____________

8940 dolomitic medium sandstone: poorly sorted (few qtz grains to 1 mm), ang to well rnd qtz

______________El Paso Fm., probable Padre Mbr.______________

8980 fine crystalline dolomite: euhedral rhombs; minor interstitial chert and silt in dolomite; dolomitic chert

9020 fine crystalline dolomite; chert; dolomitic chert

9040 fine to medium crystalline dolomite: euhedral rhombs; (ghosts of trilobite?, echinoderms?, Nuia?); dolomitic chert; approx. 1% silt in dolomite; conodonts

9090 fine and medium crystalline dolomite: euhedral and anhedral types; trace of silt in dolomite

_______El Paso Fm., lower Padre or McKelligon Mbr.______________

9110 medium crystalline dolomite and sandy dolomite: varying sizes of prominent euhedral rhombs (well rnd qtz coarse silt to very fine sand size); muddy coarse siltstone; muddy very fine sandstone, glauconite?, chert

9160 medium crystalline calcitic dolomite: anhedral crystalls

9290 medium to coarse crystalline dolomite: prominent .05-.3 mm euhedral rhombs; dolomitic chert

9300 fine and medium crystalline dolomite with minor interstitial chert

9400 lime mudstone; dolmitic lime mudstone; medium crystalline dolomite; peloid grainstone, wackestone (trilobite, echinoderm, spicules); Nuia grainstone

9450 Nuia packstone with trilobite, spicules, echinoderms; bioturbated; Nuia grainstone; silty mudstone; dedolomite

________El Paso Fm., probable near top of Hitt Canyon Mbr.____

9500 same as 9450 except 1-3% qtz silt in some of the limestones; trace of calcareous chert

_______intrusive rock similar to 7780-8100_________________

9550 altered andesite (fine crystalline diorite); andesine plagioclase, hornblende, biotite, magnetite; secondary chlorite, carbonate, clays

9590 same

__________El Paso Fm., probable Hitt Canyon Mbr.______________

9640 medium crystalline dolomite; silty mudstone; lime mudstone; dolomitic chert; Nuia grainstone

9660 silty medium crystalline dolomite; muddy coarse siltstone; silty wackestone (conodont); Nuia-echinoderm grainstone; silty triturated packstone; poorly sorted coarse siltstone with qtz grains to 1 mm

9700 silty neomorphosed wackestone and lime mudstone; dolomite; calcitic chert; most allochems triturated (Nuia, echinoderms, spicules, peloids, trilobite, conodont)

Bliss Formation

9740 sandy dolomite and dolomitic-silica-cemented fine to medium sandstone; abundant interstitial chlorite and pyrite

9770 calcareous and siliceous arkosic fine and medium sandstone; poorly sorted; subang to subrnd quartz, well rnd K-feldspar, angular plagioclase, minor glauconite

Appendix D

PETROGRAPHIC DESCRIPTIONS

ARCO Exploration Co. No. 1 Fitzpatrick Well
(10-33S-20W)

(Number in left column indicates depth at base of 10-ft interval from which the cuttings were taken)

950 dk rd brn mdst w/gypsum

1160 rhyolite, san

1500 rhyolite, san; tr ash-flow tuff

2100 brn volcaniclastics, ash-flow tuff, san, qz, rhyolite, plag

2440 brn volcaniclastics, ash-flow tuff, san, qz, rhyolite, plag

2910 brn volcaniclastics, ash-flow tuff, san, qz, rhyolite, plag; calcar; mdst

3410 silty ls, qz w/calcite cement, vol glass, rhyolite, san, misc VRF, volcaniclastics, minor plag

3600 glassy VRF (ash-flow tuff?): qz, san, plag, chl (biot), minor chty ls

3800 ash-flow tuff (glassy, few shards, qz, san plag)

4000 ash-flow tuff (glassy, few shards, qz, san plag)

4200 ash-flow tuff (glassy, few shards, qz, san plag)

4400 ash-flow tuff (glassy, few shards, qz, san plag), tr of biot

4600 AFT?, no shards, altered (chl, carb, kaol, silica); qz, san, VRF

4810 AFT glassy w/shards (qz, san, plag), spherulitic; VRF w/plag laths; intersertal and intergranular text; qz and san xl frags

5000 AFT altered, no shards; qz, san; VRF, ls-calcite

5100 AFT altered, few shards; carb, chl, silica alteration; qz, san

5200 AFT altered, few shards; carb, chl, silica alteration; qz, san w/rhy, andes, basalt VRF

5300 AFT altered, few shards; carb, chl, silica alteration; qz, san w/rhy, andes, basalt VRF

5400 AFT altered, few shards; carb, chl, silica alteration; qz, san w/rhy, andes, basalt VRF

5500 AFT altered, few shards; carb, chl, silica alteration; qz, san w/rhy, andes, basalt VRF w/tr of plag

5600 andes and basalt VRF, AFT w/shards, qz, san

5700 like 5600 w/rnd qz grains w/OG

5810 AFT (qz, san, tr of plag), rhy and andes VRF, lime mdst

Tv
Ku

5850 AFT, rhy and andes VRF, qz, san; rd-brn calcar mdst, some silty

5860 crs silty lm mdst, microspar, rd-brn calcar fn ss, lm mdst, chty microspar, unident fossil ghosts, dasyclad algae?, mollusc frag, loose pollen, 3 mm diam, .2 x .5, .15 x .7

5870 crs silty lm mdst, microspar, rd-brn calcar fn ss, lm mdst, chty microspar, unident fossil ghosts, dasyclad algae?, mollusc frag, loose pollen, 3 mm diam, .2 x .5, .15 x .7

5900 crs silty lm mdst, rd brn calcar fn ss (qz, plag, k-feld, cht), wackst w/fossil ghosts, stylolites, chty microspar, mollusc and serpulid; loose pollen .36 - 1.0 mm

5930 crs silty wackst w/micritized forams, calcar fn ss (qz, cht, k-feld) mollusc and dasyclad frags, microspar, loose pollen .2 - .8 mm

5950 calcar crs siltst-vfn ss, lm mdst, neospar fossil ghosts, tr calcar fn ss w/micro xln qz; loose pollen .25-.3 mm

5980 calcar fn ss (qz, k-feld; few rnd qz to .4 mm), fn sandy neomorph ls and chty ls, ooid?, tr of plag, pollen--one in roc frag

6000 calc fn ss (qz, plag, cht, k-feld, CRF), silty neomorph lm mdst, loose pollen

6050 calc fn-med ss (qz, cht, CRF, K-feld)

6100 calc fn-med ss (qz, cht, CRF, K-feld)

6150 calc fn-med ss (qz, cht, CRF, K-feld) w/.3mm algae?, possible miliolid

6180 dk gry neomorph lm mdst/wackst (forams w/dk mic outlines), vfn sandy lm mdst/calcar fvn ss (qz), miliolid?, tr pollen

6190 dk gry neomorph lm mdst/wackst (forams w/dk mic outlines), vfn sandy lm mdst/calcar fvn ss (qz), miliolid?, tr pollen (forams, mollusc, däsyclad?), fn qz grains, tr pollen possible packst

6200 dk gry lm mdst and fn sand wackst (3 types forams, ostracod), fn calc ss (qz, k-feld), chty lm mdst, loose pollen

6220 dk gry lm mdst and fn sand wackst (3 types forams, ostracod), fn calc ss (qz, k-feld), chty lm mdst, loose pollen w/some foram grainst, more ss, few ooids in grainst

6250 calc fn-med ss (qz, cht, k-feld) some silica cement; lm mdst, silty wackst ost, mullusc, foram, algae?), tr of pollen, poly xln qz to 1mm

6300 calcar siltst, lm mdst, wackst (foram, mollusc) tr pollen

6340 lt gry calcar fn ss (SA-SR qz, CRF?), silty mdst, poly xln qz 2.0 mm

6350 calc vfn ss (qz, cht, k-feld, plag), sandy lm mdst and wackst (microforam)

6400 calc vfn ss (qz, cht, k-feld, plag), sandy lm mdst and wackst (microforam) w/tr pollen

6450 calc fn ss and silic fn ss (qz, k-feld), lm mdst and wackst

6500 neomorph lm mdst/wackst (micritiz foram--miliolid?); tr qz

6510 neomorph lm mdst/wackst (micritiz foram--miliolid?); tr qz

6530 neomorph lm mdst/wackst (micritiz foram--miliolid?); tr qz w/mollusc frag, plag frag, cht?

6550 crs silty lm mdst and neomorph lm mdst/wackst (unid fossil ghosts, dasycl algae?

6590 neomorph dk gry lm mdst/wackst (dk brn outlines of forams, milioclid, mollusc); brn lm mdst and silty lm mdst

6600 crs silty lm mdst and neomorph lm mdst/wackst (unid fossil ghosts, dasycl algae?; ooids in neospar; authignic qz in ls

6610 neomorph dk gry lm mdst/wackst (dk brn outlines of forams, miliolid, mollusc); brn lm mdst and silty lm mdst w/some foram grainst, silty calcar sh, few ooids

6620 neomorph dk gry lm mdst/wackst (dk brn outlines of forams, miliolid, mollusc); brn lm mdst and silty lm mdst w/some foram grainst, silty calcar sh, few ooids

6630 neomorph dk gry lm mdst/wackst (dk brn outlines of forams, miliolid, mollusc); brn lm mdst and silty lm mdst w/some foram grainst, silty calcar sh, few ooids w/more ooid grainst, spar frags

6640 neomorph dk gry lm mdst/wackst (dk brn outlines of forams, miliolid mollusc); brn lm mdst and silty lm mdst w/some foram grainst, silty calcar sh, few ooids w/more ooid grainst, spar frags w/more spar, less lm mdst/wacst

6650 neospar (ooid-mollusc grainst?), foram, ost?; minor silty mdst

6660 dk gry-rd brn calcar sh and siltst (py); neomorph lm/mdst wackst/grainst (foram, ooids)

6670 dk gry neomorph wackst (foram w/dk mic walls); neospar (mollusc, foram), crs silty lm mdst (qz, cht, plag)

6680 dk gry neomorph wackst (foram w/dk mic walls); neospar (mollusc, foram), crs silty lm mdst (qz, cht, plag) w/some ooids, inocerm. columnals? in dk sh

6700 dk gry neomorph wackst (foram w/dk mic walls); neospar (mollusc, foran), crs silty lm mdst (qz, cht, plag) neomorph dk gry-brn lm mdst/wackst predon; py

6750 wackst (ghosts of forams, mulluscs, coral?); calc fn ss (qz, plag, cht)

6800 dk gry neomorph wackst (foram w/dk mic walls); neospar (mollusc, foram), crs silty lm mdst (qz, cht, plag), neomorph dk gry-brn lm mdst/wackst predon; py; (forams, ooid) grainst

6850 calc crs siltst-vfn ss (qz, plag, cht)

6900 wackst (ghosts of forams, ost?), silty lm mdst, calcar crs siltst (qz, k-feld, plag, cht)

6950 calc vfn ss (qz, plag), silic fn ss (qz, plag, k-feld, cht), sandy lm mdst and lm mdst w/tr mollusc and foram

6960 calc vfn ss (qz, plag), silic fn ss (qz, plag, k-feld, cht), sandy lm mdst and lm mdst w/tr mollusc and foram; rnd qtz w/OG

7000 brn gry lm mdst/wackst (forams); calcar crs siltst (qz, microcl, plag, chl), silty ls

7050 crs silt-fn ss (few roc frags, qz, cht, k-feld, plag), meomorph lm mdst

7100 neomorph lm mdst, silty ls, calcar vfn ss (qz, cht)

7150 rhyolite, calcar vfn ss (qz, microcl, plag), silty ls

7190 ang silt-fn qz, neomorph lm mdst, calcar siltst, cht?, rhy?

7200 neospar, cht, qz, plag;

<u>Ku</u>
Pe
7210 vfn dol, cht, crs-vfn qz

7250 vfn dol, minor cht, qz

7290 vfn dol

7350 rd-brn calcar crs siltst (qz, muscov, cht) hematitic, neomorph lm mdst (foram, pel)

7400 vfn dol, hematitic crs siltst (qz, chl)

7500 fn-vfn dol, anhed; spar w/pyrite, silty lm mdst

7600 vfn anhed dol, tr med xln dol

7700 fn anhed dol

7800 fn anhed dol w/few fossil ghosts

7900 fn anhed dol

8000 fn anhed dol but less cloudy

8090 vfn anh dol

<u>Pe</u>
Pc

8100 vfn anh dol

8110 vfn anh dol

8120 neomorph lm mdst/wackst (ech, foram), much contamination (dol, rhy, siltst, ooid-ost ls)

8150 neomorph lm mdst/wackst (foram, ost?, spar molds)

8200 neomorph lm mdst/wackst (foram, ost?, spar molds) w/ech, silty ls

8250 neomorph lm mdst/wackst (foram, ost?, spar molds)

8300 neomorph lm mdst/wackst (foram, ost?, spar molds) w/brach?

8350 neomorph lm mdst/wackst (foram, ost?, spar molds), slt silty

8400 neomorph lm mdst/wackst (foram, ost?, spar molds), dk gry, (foram, pel, sm/spar molds, gast?, ech, tril?)

8430 neomorph lm mdst/wackst (foram, ost?, spar molds), dk gry, (foram, pel, gast, bry?), stylolites

8450 lm mdst/wackst (foram, unid frags, brach spine?), crs silty ls (qz)

8500 w/gast, ech, ost?, tril?)

8550 neomorph lm mdst (foram), lt brn lm mdst

8600 neomorph lm mdst (foram), lt brn lm mdst (bioclast ghosts), minor silt

8650 lm mdst/wackst (foram, ech)

8700 lm mdst, neomorph ls, calcar siltst

8800 dk grn-gry metamorph calcar siltst, neomorph lm mdst, py

8950 dk grn-gry metamorph calcar siltst, neomorph lm mdst, py plus neomorph wackst

8900 dk grn-gry metam calcar crs silts, py

<u>Pc</u>
Pea

8950 dk grn-gry metam calcar siltst, py

9000 dk grn-gry metam calcar crs silts, py and silty ls

9050 dk gry neomorph lm mdst, py

9100 neomorph ls (fossil ghosts, ech, ost, gast?), crs silty ls, py

9110 neomorph lm mdst

9120 neomorph lm mdst/wackst (foram, ech, tril?, brach?), sml fusulinid (.4 mm)

9130 neomorph lm mdst/wackst

9130 neomorph lm mdst/wackst

9150 lm mdst, tr chty ls (ech), neomorph wackst (brach?, ech?, unident frags)

9200 neomorph lm mdst/wackst (foram, ech, intracl), med xln anhed dol

9250 neomorph lm mdst/wackst (foram, ech, intracl), med xln anhed dol plus cht

9300 neomorph ls (fn xln .02-.04 mm), few qz veins, few irreg cht patches

9400 neomorph ls (fn xln .02-.04 mm), few qz veins, few irreg cht patches w/lm mdst/wackst (ech) and med xln dol

9500 neomorph lm mdst/wackst (unident bioclasts)

9590 dk gry wackst/packst (fusul, ech, forams)

9600 neomorph lm mdst/wackst (unident bioclasts) plus lm mdst/wackst (ech, foram, tril, gast, fus?)

9610 dk gry wackst/packst (fusul, ech, forams) plus lm mdst and neomorph ls

9700 dk gry/blk neomorph lm mdst/wackst (fus), calcar crs siltst, py

9800 neomorph ls (marble), few bioclasts ghosts (fus, ech, ost?), calcar sitst, cht, chty ls, rhy

9890 spar frags to 0.6 mm

10,000 spar frags, cht, calcar crs siltst-vfn ss

10,100 spar frags (to 0.5 mm)

10,200 calcar vfn ss, spar frags

10,300 calcar vfn ss and crs siltst, spar frags

10,400 calcar crs siltst (epidote?), VRF, ls

10,450 igneous intrusive (plag (lab?) laths, chl matrix, mt), plag kaolinized, minor sericite

10,500 igneous intrusive (plag (lab?) laths, chl matrix, mt), plag kaolinized, minor sericite w/epidote

10,600 calcar crs siltst and vfn ss metam w/epidote

Pea
Ph

10,700 calcar hornfels

10,750 calcar hornfels w/bioclast ghosts

Ph
Ti

10,780 igneous intrusive (plag (lab?) laths, chl matrix, mt), plag kaolinized, minor sericite (plag(lab) laths, chl, mt, py, epidote; less clay and sericite

10,790 igneous intrusive (plag (lab?) laths, chl matrix, mt), plag kaolinized, minor sericite (plag(lab) laths, chl, mt, py, epidote; less clay and sericite

Figure 12

INTERPRETATION AND CORRELATION OF STRATIGRAPHIC UNITS IN THREE WILDCAT OIL TESTS (COYOTE, SALTY'S AND BISBEE HILLS WELLS), GRANT AND LUNA COUNTIES, NEW MEXICO