

APPENDIX A: EXPLANATION OF GEOLOGIC UNITS—Hueco Bolson

Acala, El Paso, Campo Grande Mountain, Canutillo, Cavett Lake,
 Clint, Clint NE, Clint NW, Clint SE, Diablo Canyon West, Esperanza,
 Fort Bliss NE, Fort Bliss SE, Fort Hancock, Fort Hancock NW,
 Helms West Well, Hueco Tanks, Isla, McNary, Nations East Well,
 Nations South Well, North Franklin Mountain, Padre Canyon,
 San Elizario, Smeltertown, TP Well, Tornillo, Whiterock Hills,
 Ysleta, and Ysleta NW Quadrangles,
 El Paso region, West Texas

QUATERNARY

Holocene—Late Pleistocene

Qws—Windblown sand. Coppice dunes, commonly 0.5 to 2.0 m (1.6 to 6.5 ft) high, and interdune sheet deposits; deflation areas common. May include local, undifferentiated areas of (1) active dunes (Qwsd), (2) stabilized to partly stabilized dunes that are partly vegetated (Qws2), and (3) local drainageway alluvium.

Qws2—Windblown sand area of partly vegetated, stabilized to partly stabilized dunes. Contains local areas of active sand dunes (Qwsd). Includes coppice dunes and interdune sheet deposits and deflation areas, similar to Qws areas; aerial photograph expression is more patchy/spotty than adjacent areas of Qws; commonly higher and more irregular topography than adjacent areas of Qws. May represent stabilized dune fields that formed at east side of Hueco Bolson and within the margins of the Rio Grande valley.

Qwsd—Active sand dunes. Areas of active sand dunes that are as much as 3 m (10 ft) high having sparse to no vegetation. Active sand dune areas are located within larger areas of stabilized to partly stabilized dunes that are partly vegetated (Qws2).

Qac—Slope-wash alluvium and/or colluvium. Commonly covers basin-fill deposits (QTcr, Tfh) and younger, surficial, alluvial-fan deposits, (Qf1,2,3,4) along arroyos, piedmont, and Rio Grande valley border; covers bedrock and basin-fill deposits along the margins of mountains and Diablo Plateau.

Qarg—Alluvium of Rio Grande floodplain. Sand, silt, clay, and gravel; commonly cultivated; urbanized in and near El Paso; locally covered by undifferentiated windblown sand (Qws).

Qa—Undivided alluvium of drainageways, young fans (Qf4), and young arroyo terraces (Qt4). Sand, silt, gravel, and clay; gravel locally derived. Includes undifferentiated young deposits in relatively active settings and deposits in more stable settings that contain stage I to II BK horizons. Possibly includes local undifferentiated older alluvium and younger windblown sand. May overlie or be inset against older deposits.

Qavb—Undivided alluvium of drainageways, young fans, and young arroyo terraces located along the Rio Grande valley border. Sand, gravel, silt, and clay; includes locally derived and exotic gravel. Includes undifferentiated young deposits in relatively active settings and deposits in more stable settings that contain I to II BK horizons. May include local undifferentiated older terrace or fan alluvium, small outcrops of older QTcr or Tfh, and younger windblown sand. May overlie or be inset against older deposits.

Qf4—Alluvium of young fans. Sand, gravel, silt, and clay; gravel locally derived. Includes deposits that have stage I to II BK horizons. Possibly includes local, undifferentiated drainageway alluvium, older alluvium, and windblown sand. May overlie or be inset against older deposits. Commonly <1 m to several meters thick.

Qt4—Alluvium of young terraces along large arroyos. Sand, gravel, silt, and clay; gravel locally derived. Includes deposits that have stage I to II BK horizons. Locally may include more than one terrace having similar soil characteristics. May include local undifferentiated drainageway alluvium and windblown sand. Inset against older deposits.

Qt4rg—Alluvium of young terraces and fans along the Rio Grande valley border. Sand, gravel, silt, and clay; includes locally derived and exotic gravel. Includes deposits that have stage I to II BK horizons. Locally may include more than one terrace having similar soil characteristics. May overlie or be inset against older deposits.

Qf3-4—Undivided Qf3 and Qf4 alluvium.

Qt3-4—Undivided Qt3 and Qt4 alluvium.

Late Pleistocene Deposits

Qf3—Piedmont alluvium of alluvial fans, incised alluvial fans, and bajadas. Sand, gravel, silt, and clay; gravel locally derived. Commonly contains stage III BK horizon, <0.5 m (<1.6 ft) thick. Commonly <1 m to several meters thick. May overlie or be inset against older deposits. Locally covered by younger drainageway alluvium and windblown sand. May include small deposits of older alluvium cropping out along drainageways.

Qt3—Alluvium of terraces within large arroyos. Sand, gravel, silt, and clay; gravel locally derived. Commonly contains stage III BK horizon, <0.5 m (<1.6 ft) thick. Locally may include more than one terrace having similar soil characteristics. Inset against older deposits. Locally covered by younger drainageway alluvium and windblown sand.

Qt3rg—Alluvium of terraces and alluvial fans located along Rio Grande valley border. Sand, gravel, silt, and clay; includes locally derived and exotic gravel. Commonly contains stage III BK horizon, <0.5 m (<1.6 ft) thick. Locally may include more than one terrace having similar soil characteristics. May overlie or be inset against older deposits. Locally covered by undifferentiated younger drainageway alluvium and windblown sand.

Late Pleistocene to Middle Pleistocene

Qf2—Piedmont gravel and sand alluvium of alluvial fans, incised fans, and bajadas. Sand, gravel, silt, and clay; includes locally derived gravel. Commonly contains stage IV K horizon calcrete, 0.2 to 1.0 m (0.6 to 3.0 ft) thick. Commonly as much as several meters thick. May overlie or be inset against older deposits. Locally covered by undifferentiated younger alluvium and windblown sand.

Qt2—Alluvium of terraces along large arroyos. Sand, gravel, silt, and clay; gravel locally derived. Commonly contains stage IV K horizon calcrete, 0.2 to 1.0 m (0.6 to 3.0 ft) thick. Locally may include more than one terrace having similar soil characteristics. Inset against older deposits. Locally covered by undifferentiated younger alluvium and windblown sand.

Qtrg2—Alluvium of terraces and alluvial fans along Rio Grande valley border. Sand, gravel, silt, and clay. Includes locally derived gravel and exotic gravel. Commonly contains stage IV K horizon calcrete, 0.2 to 1.0 m (0.6 to 3.0 ft) thick. Locally may include more than one terrace having similar soil characteristics. May overlie or be inset against older deposits. Locally covered by undifferentiated younger alluvium and windblown sand.

Qf1-2—Undivided Qf1 and Qf2 alluvium.

Qf2-3—Undivided Qf2 and Qf3 alluvium.

Middle Pleistocene

Qf1—Alluvium of alluvial fans, bajadas, and alluvial plains. Sand, gravel, silt, and clay; gravel generally locally derived, local exotic gravel along Rio Grande valley border. Commonly contains stage IV to V K horizon calcrete, 0.7 to 1.5 m (2.3 to 5.0 ft) thick. Locally may be covered by younger alluvium and windblown sand. Northwest of Alamo arroyo along the Rio Grande Valley border, local Qf1 mostly not divided from upper QTcr, and only QTcr mapped. Southeast of Alamo arroyo, undivided Qf1+QTcr mapped. Surface of Qf1 approximately equivalent to Jornada I surface of Mesilla basin, southern New Mexico; locally may be equivalent to La Mesa surface if some Qf1 alluvial deposits are time-equivalent facies of Camp Rice fluvial deposits.

Pleistocene to Pliocene

QTl—Landslide deposits. Does not include probable Crazy Cat landslide (located west of south tip of Franklin Mountains, [Lovejoy, 1976]), which is mapped as bedrock units surrounded by alluvium.

Middle Pleistocene to Pliocene

QTcr—Camp Rice Formation. Sand and gravel; lesser amounts of silt and clay. Represents fluvial, alluvial-fan, floodplain, and minor lacustrine deposition. Constructive depositional surface commonly contains stage V K horizon calcrete, 1.0 to 1.5 m (3.0 to 5.0 ft) thick. Ash at top of unit assigned as 0.6-m.y.-old Lava Creek B ash (Izett, 1981; Izett and Wilcox, 1982; location in El Paso, Texas). Ash in lower part of unit assigned as 2.1-m.y.-old Huckleberry Ridge ash (Izett, 1981; Izett and Wilcox, 1982; locations in Arroyo Diablo and Madden Arroyo, Campo Grande Mountain, Texas Quadrangle). Locally covered by younger alluvium and windblown sand. Upper Camp Rice deposits along valley border may include local, high, undivided, middle Pleistocene Rio Grande terrace deposits (approximately equal in age to Qf1 deposits) that are incised into older QTcr and undivided local middle Pleistocene piedmont fan alluvium (Qf1) that overlies older QTcr. Northwest of Alamo arroyo, c indicates calcic soil of upper Camp Rice or unmapped local terrace and fan alluvium (unmapped QF1). Areas mapped as Camp Rice along valley border slopes include small, undivided deposits of younger terrace, fan, and drainageway alluvium. Depositional surface of QTcr equivalent to La Mesa surface of Mesilla basin, southern New Mexico.

Qf1 + QTcr—Undivided Qf1 and QTcr.

Pliocene

Tfh—Fort Hancock Formation. Lacustrine clay, bedded gypsum (southeastern Hueco Bolson), and silt; alluvial-fan gravel, sand, silt, and clay; minor fluvial deposits. Blanford vertebrate fossils. Locally covered by younger alluvium and windblown sand.

Finlay Mountains and Diablo Plateau

TERTIARY

Ti—Undifferentiated intrusive igneous rocks. Dikes and sills of andesite porphyry, hornblende andesite porphyry, and latite porphyry in Finlay Mountains. Many small dikes and sills not shown. K-Ar ages of some Finlay Mountain intrusions range between about 46 and 50 m.y. (Matthews and Adams, 1986).

LOWER CRETACEOUS

Kf—Finlay Formation. Limestone, marl, shale, and sandstone. Gray; abundant marine microfossils and macrofossils. In Finlay Mountains, mostly medium and thin beds and nodular; some thick and massive beds; thin sandstone beds near base; ~61 m (~200 ft) thick. In Diablo Plateau area, mostly limestone along rimrock of plateau; sandstone beds near base; ~53 to 61 m (~175 to 200 ft) thick.

Kcx—Cox Sandstone. Quartz sandstone, conglomerate, limestone, and shale. Mostly quartz sandstone; fine to medium grained, thin to thick bedded, crossbedded, and rippled. Contains silicified wood; some silicified branches and logs several feet long. Fossiliferous limestone common in upper half of unit. Various shades of brown, gray, orange, and pink; ~152 m (~500 ft) thick at Diablo Plateau; ~165 to 206 m (~540 to 675 ft) thick in Finlay Mountains; ~213 to 226 m (~700 to 740 ft) thick at Campo Grande Mountain.

Kb—Bluff Mesa Formation. Limestone and sandstone; some limestone conglomerate and sandy shale. Locally crops out in hills northwest of Campo Grande Mountain on upper Laramide thrust plate of area; basinward facies approximately equivalent to Campagrande Formation (Kca).

Kca—Campagrande Formation. Limestone, marl, conglomerate, sandstone, siltstone, and shale. Interbedded limestone and marl in upper 61 to 76 m (200 to 250 ft); thin to thick beds;

gray. Lower part interbedded sandstone, fossiliferous limestone, siltstone, sandy shale, and limestone and chert conglomerate; ~114 m (~375 ft) thick in northwest Finlay Mountains; ~244 m (~800 ft) thick in southwest Finlay Mountains.

PERMIAN

Pl—Limestone, Leonard Series.

Pm—Marl and limestone, Leonard Series.

Franklin Mountains

TERTIARY

Ti—Undivided intrusive rocks. Includes Campus Andesite west of Crazy Cat Mountain and other andesite intrusions west of mountains; felsite dikes and sills unmapped in mountain range.

K-Ar age of Campus Andesite intrusion ~48 m.y. (Hoffer, 1970; Henry and others, 1986).

CRETACEOUS

K—Undivided Cretaceous strata. Mostly limestone and marl.

PERMIAN

Ph—Hueco Group. Limestone, dolomitic limestone to dolostone, siltstone, shale; thin to thick bedded; generally light gray; ~670 m (~2,200 ft) thick.

PENNSYLVANIAN

Magdalena Group

IPmps—Panther Seep Formation. Argillaceous limestone, gypsum beds, silty shale, chert-pebble conglomerate. Conglomerate marks base of unit; gypsum beds 2 to 12 m (6.5 to 39 ft) thick; generally forms gentle slopes; ~360 m (~1,180 ft) thick.

IPmbc—Bishop Cap Formation. Shale, limestone. Composed primarily of poorly exposed shale along with some thin, resistant beds of limestone; ~194 m (~636 ft) thick.

IPmb—Berino Formation. Limestone, shale. Composed primarily of alternating limestone and shale units ~0.6 to 6 m (~2 to 20 ft) thick; shale dominates base of unit; ~21 m (~70 ft) of massive, resistant limestone at top of unit. Common fossils include mollusks, brachiopods, corals, bryozoans, and fusulinids. Total thickness ~137 m (~448 ft).

IPml—La Tuna Formation. Limestone. Cherty; massive limestone beds at base; shale interbeds increase upward and unit more thinly bedded upward. Resistant to weathering; forms cliffs. Common fossils include silicified corals, brachiopods, crinoids, mollusks, bryozoans; some petrified wood; ~85 m (~280 ft) thick.

MISSISSIPPIAN

Mh—Helms Formation. Shale, some limestone. Shale calcareous and gray. Limestone locally oolitic; contains traces of quartz sand; commonly <0.3 m (<1 ft) thick. Limestone interbeds as thick as 1 m (3 ft) more common in upper part of unit. Fossils include brachiopods, gastropods, ostracodes, crinoids, and bryozoans; ~46 to 70 m (~150 to 230 ft) thick; thins northward.

Mrl—Undivided Rancheria and Las Cruces Formations. Rancheria Formation; limestone, some siltstone and shale. Lower part mostly cherty limestone, along with some siltstone and shale interbeds; ~40 m (~130 ft) thick; limestone beds as thick as 0.6 m (2 ft); siltstone and shale beds as thick as 2 m (7 ft). Middle part black limestone; 8.5 to 12.8 m (28 to 42 ft) thick; forms

light-gray band in weathered hillsides. Upper part limestone containing siltstone and shale near the top; limestone black, cherty, and sandy; ~61 to 70 m (~200 to 230 ft) thick. Las Cruces Formation; limestone. Evenly bedded; beds ~0.3 to 0.6 m (~1 to 2 ft) thick; mostly chert free; weathers white to light gray and commonly forms distinct band at the base of ledgy cliffs; ~15 to 27.5 m (~50 ft to 90 ft) thick.

DEVONIAN

Dpc—Undivided Canutillo Formation and Percha Shale. Limestone, shale, marl, and some siltstone. Canutillo limestone, shale, marl, and siltstone, ~41 m (~135 ft) thick, overlain by 12-m-thick (40-ft) Percha black shale. Lower part of Canutillo shale, limestone, and dolomite breccia (derived from Fusselman Dolomite) overlain by interlensed chert and marl. Chert lenses 0.15 to 0.6 m (0.5 to 2 ft) thick. Upper part of Canutillo calcareous dark-gray shale interbedded with thinner (<0.3-m-thick [<1-ft]) beds of dark-gray marl and limestone. Local evidence that some lower Canutillo strata were deposited in sinkholes or channels in underlying Fusselman Dolomite.

SILURIAN

Sf—Fusselman Dolomite. Dolostone, some limestone. Mostly light-gray to tan dolostone; some gray limestone patches surrounded by dolomite/dolostone in upper part of unit; minor chert; karst breccia. Resistant to weathering; forms massive cliffs. Fossils include brachiopods, corals, and gastropods; ~152 to 183 m (~500 to 600 ft) thick.

UPPER AND MIDDLE ORDOVICIAN

Om—Montoya Group. Dolostone, some limestone, marl, and shale. Includes undivided lower, 30.5-m-thick (100-ft) Upham Dolomite, middle, 46-m-thick (150-ft) Aleman Formation, and upper, 39.5- to 50-m-thick (130- to 165-ft) Cutter Formation. Upham massive, gray dolostone.

Aleman dark-gray dolostone commonly interlayered with chert lenses and nodules. Cutter ~9 m (~30 ft) of nodular marl, dolostone, limestone, and shale overlain by cliff-forming, 0.6- to 1.8-m-thick (2- to 6-ft), evenly bedded, light-gray dolostone. Karst breccia common. Fossils include brachiopods, corals, and gastropods and abundant dolomitized fossil debris.

LOWER ORDOVICIAN

Oe—El Paso Group. Limestone, dolostone, sandy dolostone, and some dolomitic sandstone. Massive to thin bedded; some crossbeds and cross-laminations; some chert; karst breccia. Several published subdivisions of these cyclic, shelfal carbonate strata exist. Seven formations (LeMone, 1968, 1988) include, from base to top: (1) 26 to 49 m (85 to 160 ft) of Sierrite sandy dolostone, (2) ~33 m (~110 ft) of Cooks dolomite, (3) ~88 m (~290 ft) of Victorio Hills limestone and dolostone, (4) 21 to 27.5 m (70 to 90 ft) of José sandy, crossbedded dolostone, massive dolostone, and dolomitic sandstone, (5) 173 to 210 m (570 to 690 ft) of McKelligon Canyon limestone and dolostone (upper 7.6 m [25 ft]), (6) ~88 m (~290 ft) of Scenic Drive dolomitic sandstone (base), sandy dolostone and dolostone (lower 18 to 30.5 m [60 to 100 ft]), and limestone (upper part), and (7) ~12 m (~40 ft) of Florida Mountains limestone. Common fossils include snails, brachiopods, trilobites, and conodonts.

LOWER ORDOVICIAN – UPPER CAMBRIAN (?)

Ocb—Bliss Sandstone. Quartz-rich sandstone, quartzite, and siltstone. Fine to medium grained; medium to thick bedded; laminated and cross-laminated; glauconitic in upper half; weathers dark reddish-brown. Sparse fossils include brachiopods, gastropods, rare trilobites; some trace fossils. As thick as 76 m (250 ft); locally absent.

PRECAMBRIAN

pCg—Undivided porphyritic granite, biotite granite, biotite-hornblende granite, riebeckite granite, and associated pegmatite, aplite, and basalt (**pCb**) dikes. Includes granites of Red Bluff Granite complex. Granite commonly medium to coarse grained, massive, and pink to red. Intrudes all other Precambrian rocks. May include local, undifferentiated rhyolite (**pCr**).

pCr—Undivided Thunderbird Group. (1) Rhyolitic ignimbrites and porphyritic rhyolite dikes (upper Tom Mays Park Formation; as thick as 168 m [550 ft]); (2) porphyritic trachyte, tuffaceous sandstone and conglomerate, and ignimbrite (middle Smugglers Pass Formation; as thick as 140 m [460 ft]); and (3) rhyolite-cemented conglomerate of cobble- to pebble-sized quartzite, siltstone, shale, chert, ignimbrite, and trachyte (lower Coronado Hills Formation; 11 to 27 m [35 to 90 ft] thick).

pCl—Lanoria Quartzite. Quartzite, sandstone, siltstone, and shale. Three members include (1) lower Lanoria (**pClI**); 320 m (1,050 ft) thick; fine-grained quartzite, sandstone, siltstone, and shale; commonly forms slopes; (2) middle Lanoria (**pClm**); 183 to 243 m (600 to 800 ft) thick; medium-grained quartzite, crossbedded; commonly forms cliffs; (3) upper Lanoria (**pClu**); 168 to 213 m (550 to 700 ft) thick; fine-grained quartzite, sandstone, siltstone, shale; thin bedded; commonly forms slopes.

pCmc—Undivided Mundy Breccia and Castner Limestone. Mundy Breccia: randomly oriented, black basalt boulders, angular to slightly rounded, in matrix of dark-gray mudstone; as thick as 76 m (250 ft). Castner Limestone: limestone, hornfels, conglomerate, dolomite, and diabase; mostly limestone, slightly metamorphosed, some chert lenses, thin bedded, containing metamorphic minerals that include serpentine, tremolite, and garnet; numerous thin beds of hornfels in upper third of unit, very fine grained, laminated; some conglomerate in upper third of unit; dolostone in basal part of unit; local algal structures; diabase sills near base and middle, dark greenish gray, thin to thick, constituting about one-third of unit; thickness of formation ~335 m (~1,100 ft); base not exposed.

Hueco Mountains

TERTIARY

Ti—Undivided intrusive rocks. Includes syenite to monzonite rocks of Hueco Tanks area; small sills and dikes unmapped. K-Ar ages of Hueco Tanks and some nearby intrusions range between 33 and 35 m.y. (Wise, 1977; Henry and others, 1986).

PERMIAN

Ph—Hueco Group, undivided. Limestone, dolomitic limestone, marl, siltstone, shale; fossiliferous; cherty; lower part may comprise chert and limestone clasts in limestone matrix, mudstone, and marl. Generally light gray to dark gray; maximum thickness 455 m (1,500 ft). Lower contact with Magdalena Group is angular unconformity. Four units separately mapped (from base to top): **Php—Powwow Conglomerate.** Limestone and chert-pebble conglomerate, mudstone, and marl; 0 to ~30 m (0 to ~100 ft) thick. **Phl—lower Hueco Group/Hueco Canyon Formation.** Limestone and dolomitic limestone, medium to thick bedded; cherty; fossiliferous; ~90 to ~150 m (~300 to ~500 ft) thick (as much as 200 m [650 ft] thick outside map area). **Phm—middle Hueco Group/Cerro Alto Formation.** Limestone, dolomitic limestone, marl, and shale interbeds; fossiliferous; ~75 to ~110 m [~250 to ~350 ft] thick (as much as 137 m [450 ft] thick outside map area). **Phu—upper Hueco Group/Alacran Mountain Formation.** Limestone, medium to thick bedded; mudstone, including reddish-brown mudstone and cherty, medium-bedded limestone interval, Deer Mountain Red Shale; fossiliferous; minor thickness crops out in map area (~150 to ~275 m [~500 to ~900 ft] thick outside map area)

PENNSYLVANIAN

IPm—Magdalena Group, undivided. Limestone, marl, shale. Massive to medium beds; fossiliferous; cherty; ~400 m (~1,300 ft) thick. Upper contact with Hueco Group is angular

unconformity. Three units separately mapped (from base to top): **IPml—lower Magdalena Group.** Limestone. Thick to medium bedded; cherty; fossiliferous, coral common, crinoids, mollusks, brachiopods, fusulinids; ~150 m (~500 ft) thick. **IPmm—middle Magdalena Group.** Marl, shale, and limestone. Fossiliferous; fusulinids, coral, algae; ~90 m (~300 ft) thick. **IPmu—upper Magdalena Group.** Limestone, marl. Massive to medium beds; cherty; local reef complex; fossiliferous, fusulinids, pelecypods, coral, crinoid fragments; as much as 140 m (450 ft) thick.

MISSISSIPPIAN

Mhr—Helms Formation and Rancheria Formation, undivided. Limestone, sandy limestone, and shale. Undivided unit grades upward from limestone and cherty limestone to sandy limestone and shale. Locally fossiliferous. As much as 170 m (550 ft) thick. Rancheria Formation (lower unit), cherty limestone and sandy limestone, contains Meramec fossils; as much as 45 m (150 ft) thick. Helms Formation (upper unit) sandy limestone and shale, contains Chester fossils; as much as 120 m (400 ft) thick.

DEVONIAN

Dpc—Devonian Percha Shale and Canutillo Formation, undivided. Shale, bedded chert, marl, and limestone. As much as 50 m (170 ft) thick (as much as 75 m [240 ft] thick outside of map area) Canutillo Formation (lower unit) composed of ≤ 30 m (≤ 100 ft) of bedded chert, along with marl and limestone interbeds; outcrops generally poor. Percha shale ≤ 30 m (≤ 100 ft) thick shale unit that rarely crops out owing to weathering.

SILURIAN

Sf—Fusselman Dolomite. Dolostone, dolomitic limestone, and limestone. Light gray; cherty interval in lower part; karst breccia; local fossils; ~180 m (~600 ft) thick.

UPPER AND MIDDLE ORDOVICIAN

Om—Montoya Group. Limestone, dolomitic limestone and dolostone. Karst breccia; local fossils. Montoya Group includes undivided lower 30-m-thick (100-ft) Upham Formation, middle 50-m-thick (160-ft) Aleman Formation, and upper 45-m-thick (155-ft) Cutter Formation. Upham massive, gray and brown dolostone, dolomitic limestone, and limestone. Aleman mostly limestone and cherty limestone; dark gray to tan. Cutter mostly white to light-gray dolostone and dolomitic limestone.

LOWER ORDOVICIAN

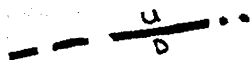
Oe—El Paso Group. Limestone, dolomitic limestone, dolostone, sandy limestone and dolostone, and dolomitic sandstone. Massive to thin bedded; some crossbeds and cross-laminations; some chert; karst breccia; ~415 m (1,370 ft) thick.

LOWER ORDOVICIAN — UPPER CAMBRIAN (?)

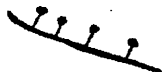
OEb—Bliss Sandstone. Quartz-rich sandstone and siltstone. Fine to coarse grained; medium to thick bedded; crossbedded and cross-laminated; glauconitic; weathers reddish-brown; as much as 110 m (325 ft) thick.

PRECAMBRIAN

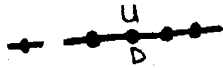
pCg—Granite and associated intrusive rocks.



Normal fault. U = upthrown, D = downthrown.



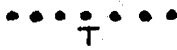
Known lower angle normal fault. Bar on footwall block.



Sand-covered scarp. Possible normal fault scarp covered by windblown sand. U = upthrown, D = downthrown.



Reverse fault. Teeth on upthrown side.



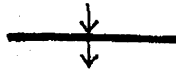
Covered thrust fault. T indicates upper plate. Marks approximate edge of Laramide thrusting.



Fissure



Strike and dip of beds.



Monocline.



Ash; assigned as 2.1-m.y.-old Huckleberry Ridge ash by Izett (1981) and Izett and Wilcox (1982).