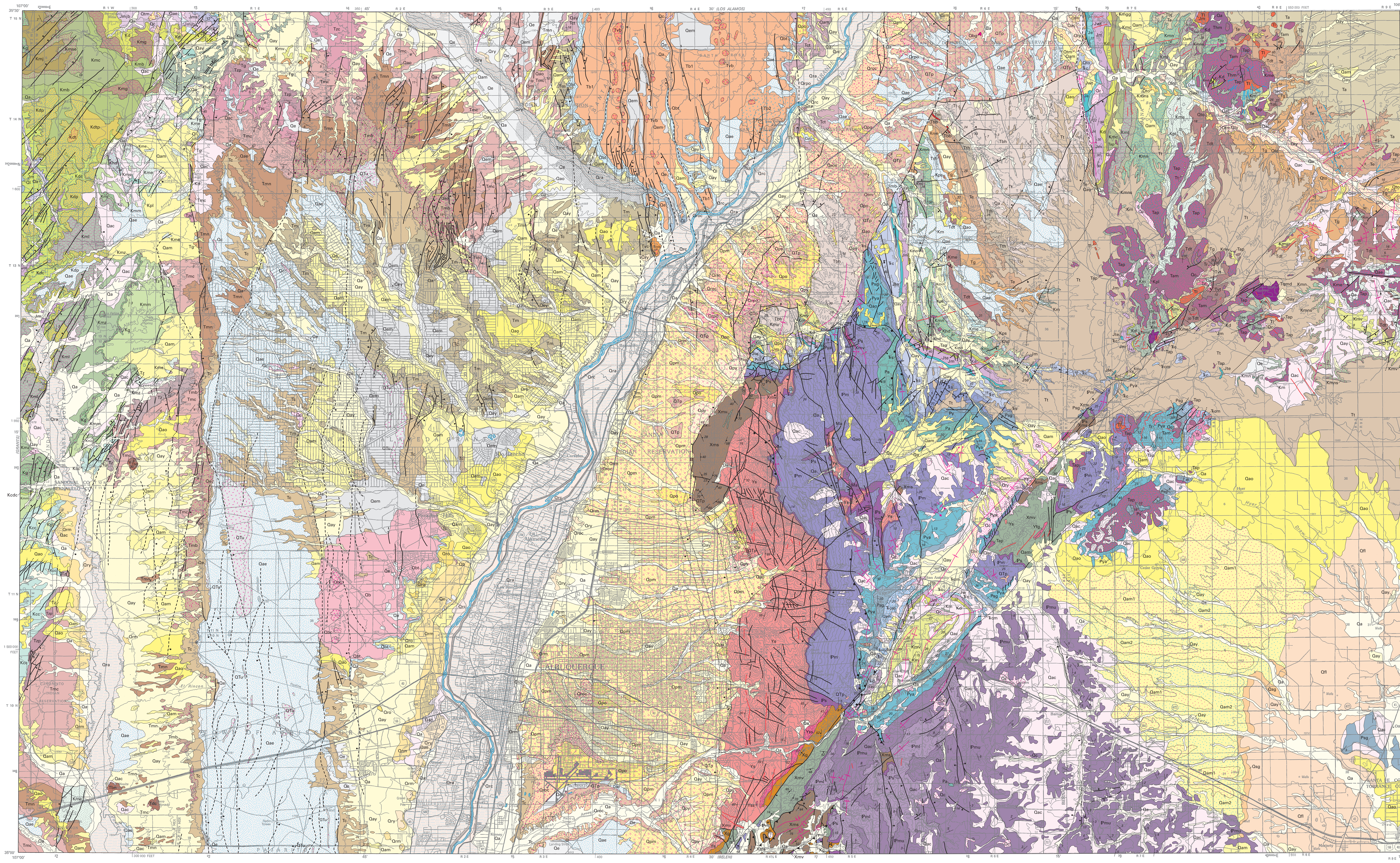

Geology compiled in 2003–2004 from sources listed in report (see fig. 2).
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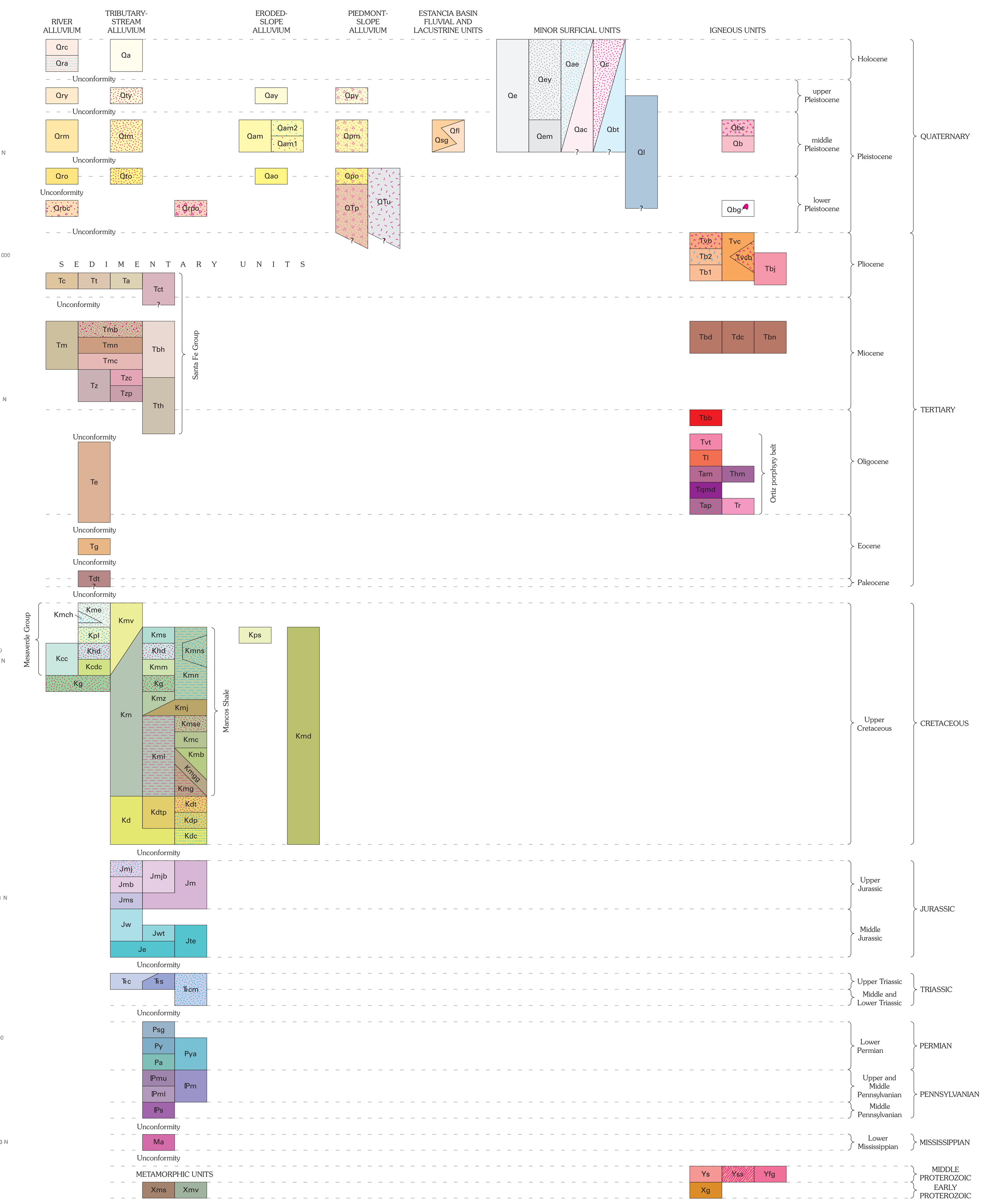
CORRELATION OF MAP UNITS



MESOZOIC SEDIMENTARY UNITS

Mesaverde Group (Upper Cretaceous)

Kmv **Mesaverde Group, undivided**—Dark-gray and olive-gray shale and light-yellow and light-brown sandstone; contains coal seams in upper part. Dominantly nonmarine strata. Thickness more than 1,000 ft; locally subdivided into units Kme through Kcdc:

Kme **Menefee Formation**—Gray, light-brown, and orange-brown sandstone with gray and olive-gray shale and coal. Thickness about 1,250 ft

Kmch **Medial sandstone member**—Light-gray and light-brown, medium-grained, well-sorted, crossbedded fluvial sandstone. Designated as the "Cliff House Tongue" in the Hagan Basin (Cather and others, 2002) and as the "Harmon Sandstone" in the Madrid area (Maynard and others, 2001). Thickness about 330 ft

Kpl **Point Lookout Sandstone**—Light-gray, light-brown, and drab-yellow, fine- to medium-grained sandstone with thin interbeds of gray shale. Thickness 125–300 ft

Kcc **Crevasse Canyon Formation, undivided**—Dark-gray and olive-gray shale with gray, yellow, and brown sandstone and coal. Thickness about 800 ft. Subdivided where appropriate as units Khd and Kcdc:

Khd **Hosta Tongue of the Point Lookout Sandstone and Dalton Sandstone Member, undivided**—Yellow-gray and yellowish-brown, fine- to medium-grained, moderately cemented sandstone with minor olive-brown shale lenses. Thickness 220–370 ft

Kcdc **Dilco Coal Member**—Dark-gray carbonaceous shale, silty and sandy shale, and coal. Thickness 0–100 ft

Kg **Gallup Sandstone (Upper Cretaceous)**—Yellowish-gray and yellow, medium- to coarse-grained, crossbedded sandstone. Youngest major regressive marine sandstone deposit in the region. Thickness 0–60 ft

Mancos Shale (Upper Cretaceous)

Km **Mancos Shale, undivided**—Dominantly gray to olive-gray sandy shale, yellowish sandstone, and argillaceous limestone. Major marine unit of shale and littoral sandstone that represents the youngest (last) marine deposition in the region. Subdivided into units Kms through Kmg:

Kms **Satan Tongue**—Dark-gray to olive-gray shale, silty shale, and subordinate very fine grained and fine-grained sandstone with local gypsum. Thickness 240–440 ft

Kmm **Mulatto Tongue**—Dark- to light-gray and olive-gray shale, silty and sandy shale, and fine-grained ripple-marked sandstone. Lateral equivalent of the El Vado Sandstone Member (Landis and Dane, 1967). Thickness 380–500 ft

Kmz **Montezuma Valley Member**—Gray to olive-gray, well-indurated, slightly silty-sandy calcareous shale with numerous septarian concretions, carbonaceous plant material, and ammonites (Leckie and others, 1997). Thickness about 165 ft in this area

Kmn **Niobrara Shale Member**—Yellowish-brown to gray, thin-bedded sandy marine shale containing brown calcareous concretions as large as 2 ft in diameter. Total thickness is variable, 280–1,350 ft

Kmns **Sandstone lentil**—Light-yellowish-gray, thin-bedded sandstone. Thickness about 110 ft

Kmj **Juana Lopez Member**—Gray to light-yellowish-brown, fetid, calcareous silty shale and fossiliferous calcarenite. Thickness 3–100 ft

Kml **Mancos Shale, lower part, undivided**

Kmse **Semilla Sandstone Member**—Discontinuous lenses of yellowish-gray and light-brown, very fine grained to coarse-grained, crossbedded sandstone. Thickness 0–60 ft

Kmc **Carlile Member**—Medium-gray, thin-bedded marine shale. Thickness 300–370 ft

Kmb **Bridge Creek Limestone Member**—Medium-gray calcareous marine shale. Thickness about 190 ft

Kmgg **Greenhorn Limestone Member and Graneros Member, undivided**—Greenhorn Limestone Member is thin-bedded argillaceous marine limestone with interbedded calcareous shale. Total thickness 210–230 ft

Kmg **Graneros Member**—Medium-gray marine shale. Thickness about 190 ft

Kps **Point Lookout Sandstone of the Mesaverde Group and Satan Tongue of the Mancos Shale, undivided (Upper Cretaceous)**

Kmd **Mancos Shale and Dakota Sandstone, undivided (Upper Cretaceous)**

Kd **Dakota Sandstone, undivided (Upper Cretaceous)**—Yellowish-gray to yellowish-orange, fine- to medium-grained sandstone and silty sandstone with local pebble conglomerate lenses. Littoral sand body, interbedded with variable amounts of marine Mancos Shale. The Dakota is a major transgressive unit that marks the initial Cretaceous marine flooding of the continental interior. Total thickness variable from 25 to 270 ft; locally subdivided into units Kdt through Kdc:

Kdt **Twowells Tongue**—Yellowish-gray, lenticular, fine-grained sandstone; as compiled, map unit includes the Whitewater Arroyo Tongue of the Mancos Shale. Thickness 0–50 ft

Kdp **Paguate Tongue**—Yellowish-gray, fine- to medium-grained sandstone; as compiled, unit includes the Clay Mesa Tongue of the Mancos Shale. Thickness about 100 ft

Kdtp **Twowells and Paguate Tongues, undivided**

Kdc **Cubero Tongue**—Yellowish-orange, fine- to medium-grained, slabby, thin-bedded sandstone with conspicuous bioturbation. May include the Oak Canyon Member of the Dakota Sandstone in western part of map area. Thickness about 120 ft

Jm **Morrison Formation, undivided (Upper Jurassic)**—Gray, white, and light-brown, quartz-rich and arkosic sandstone with gray, green, maroon, and light-brown, mudstone, and minor conglomerate. Thickness about 850 ft

Jmj **Jackpile Sandstone Member**—Gray to white, kaolinitic, fine- to coarse-grained, quartzose, crossbedded sandstone and grayish-green and maroon mudstone. Thickness about 200 ft

Jmb **Brushy Basin Member**—Gray, green, and maroon mudstone with minor gray and light-brown, fine- to medium-grained sandstone. Thickness about 450 ft

Jmjb **Jackpile Sandstone and Brushy Basin Members, undivided**

Jms **Salt Wash(?) Member**—Gray to light-yellowish-brown, coarse-grained, crossbedded fluvial sandstone with minor grayish-green and light-brown mudstone, and sparse conglomerate lenses. Correlation of these beds with the Salt Wash Member is uncertain (Lucas and others, 1999b). Thickness about 200 ft

Jw **Wanakah Formation (Middle Jurassic)**—Light-red, fine-grained sandstone and red to greenish-gray mudstone with minor thin beds and nodules of limestone. Thickness about 160 ft

Jwt **Todilto Member**—Upper part is white to gray, bedded and nodular gypsum, equivalent to the Tonque Arroyo Member of the Todilto Formation of Lucas and others (1995); about 215 ft thick. Lower part is gray, fetid, micritic limestone containing dark-brown to black carbonaceous mudstone and thin gypsum beds, equivalent to the Luciano Mesa Member of the Todilto Formation of Lucas and others (1995); about 20 ft thick

Je **Entrada Sandstone (Middle Jurassic)**—Upper part is yellowish-gray, light-orange, and light-brown, fine- to medium-grained, weakly cemented, crossbedded and tabular-bedded sandstone (assigned to the Slick Rock Member by Lucas and others, 1995); 35–65 ft thick. Lower part is reddish-brown siltstone and sandstone; (assigned to the Dewey Bridge Member by Lucas and others, 1995); 66–80 ft thick. Total thickness 100–145 ft

Jte **Todilto Member of Wanakah Formation and Entrada Sandstone, undivided (Middle Jurassic)**

TRc **Chinle Formation (Upper Triassic)**—Reddish-brown, nonmarine mudstone, reddish-brown, medium-grained sandstone with minor mudstone beds, and reddish-brown, purple, and greenish-gray mudstone with minor silty sandstone and limestone-pebble conglomerate lenses; pervasive gypsum. Includes variegated mudstone unit correlated with the Petrified Forest Member. Total thickness of the Chinle is 1,200–1,650 ft

TRs **Santa Rosa Formation (Upper Triassic)**—Light-gray, light-brown, and reddish-brown, crossbedded, nonmarine sandstone and variegated mudstone. Equivalent to the Agua Zarca Formation of Lucas and Heckert (1996). Thickness 100–220 ft

TRcm **Chinle and Moenkopi Formations, undivided (Triassic)**—Chinle Formation as previously described. Moenkopi Formation (Middle? and Lower Triassic) is maroon and brown, thin- to thick-bedded, fine-grained, nonmarine, micaceous sandstone and siltstone, with minor interbedded reddish-brown mudstone. Thickness 45–100 ft

PALEOZOIC SEDIMENTARY UNITS

Psg **San Andres Limestone and Glorieta Sandstone, undivided (Lower Permian)**—San Andres Limestone is light-gray and light-brown, thin- to medium-bedded limestone interbedded with light-gray quartz sandstone lenses near base; thickness 80–130 ft. Glorieta Sandstone is white to light-gray, thick-bedded, well-indurated, medium-grained quartz arenite; locally includes a thin, greenish-yellow, silty mudstone near the top, about 3 ft thick; total thickness 35–50 ft

Py **Yeso Formation (Lower Permian)**—Light-brown, very fine grained, silty gypsiferous sandstone and light-brown, light-red, and gray, ripple-laminated sandstone. Thickness about 175 ft

Pa **Abo Formation (Lower Permian)**—Reddish-brown mudstone alternating with grayish-white and light-orange lenticular beds of coarse-grained conglomeratic arkose. Thickness about 1,000 ft

Pya **Yeso and Abo Formations, undivided (Lower Permian)**

IPm **Madera Formation (Upper and Middle Pennsylvanian)**—Gray arkosic limestone, subarkosic sandstone, and dense limestone. Thickness about 1,260 ft. Locally subdivided into units IPmu and IPml:

IPmu **Upper arkosic limestone member**—Gray, greenish-gray, olive-gray, and brown limestone interbedded with layers of variegated subarkosic sandstone and mudstone. Thickness about 600 ft

IPml **Lower gray limestone member**—Gray, ledge-forming cherty limestone with thin interbeds of variegated limestone. Thickness about 650 ft

IPs **Sandia Formation (Middle Pennsylvanian)**—Interbedded brown claystone, gray limestone, and olive-brown and gray subarkosic sandstone. Thickness about 190 ft

Ma **Espiritu Santo Formation of the Arroyo Penasco Group (Lower Mississippian)**—Green and purplish-brown sandstone and stromatolitic limestone and dolomite. A basal 6-ft cobble conglomerate rests on the beveled surface of Proterozoic rocks (equivalent to the Del Padre Sandstone Member of the Espiritu Santo Formation of Armstrong and Mamet, 1974). Discontinuously preserved in the Sandia Mountains. Maximum total thickness about 73 ft

PROTEROZOIC METAMORPHIC UNITS

Xms **Metasedimentary rocks (Early Proterozoic)**—Red-brown, strongly crenulated mica schist, quartz-muscovite schist, metaquartzite (some crossbedded), and quartz-chlorite schist

Xmv **Metavolcanic rocks (Early Proterozoic)**—Greenish-gray, chlorite-amphibole phyllite and schist, gray and light-green metadacite tuff, greenschist derived from basalt and andesite, and reddish-orange, banded metarhyolite

IGNEOUS UNITS

Qbc **Basaltic cinder and spatter-cone deposits (middle Pleistocene)**—Vent deposits on top of Albuquerque volcanoes field west of the Rio Grande (The Volcanoes)

Qb **Basalt flows (middle Pleistocene)**—Alkali olivine basalt pahoehoe flows erupted within the Albuquerque volcanoes field west of the Rio Grande (The Volcanoes). Consists of plagioclase and olivine phenocrysts in aphanitic, vesicular matrix. Eruption dated at 156 ka by Peate and others (1996); flows interbedded with Segundo Alto fluvial terrace-fill deposits (Qrm)

Qbg **Guaje Pumice Bed (Otowi Member) of the Bandelier Tuff (lower Pleistocene)**—Primary and slightly reworked pumice erupted at about 1.6 Ma from the Valles Caldera north of quadrangle; occurs as intermittent bed within the older Rio Grande terrace-fill deposit (Cuarto Alto) of the Albuquerque valley (Qroc) and within older piedmont-slope alluvium (QTp) near north edge of quadrangle

Tvb **Basaltic vent breccia and cinder deposits (upper Pliocene)**—Cinder-cone and spatter deposits on top of basalt flows at Santa Ana Mesa. Youngest eruptive products may be lower Pleistocene

Tb2 **Younger basalt of Santa Ana Mesa (upper Pliocene)**—Alkali olivine basalt

Tb1 **Older basalt of Santa Ana Mesa (upper Pliocene)**—Alkali olivine basalt flows overlying basal hydromagmatic basaltic tuff. Tuff deposit covers a slightly eroded paleotopographic surface. Oldest flows dated at 2.7 Ma (Smith and Kuhle, 1998). Thickness variable but locally as much as 200 ft

Tvc **Canjilon tuff (upper Pliocene)**—Basaltic tuff-breccia deposit erupted in oval diatreme through the upper part of the "Middle red" formation (Santa Fe Group) southwest of Santa Ana Mesa (Kelley and Kudo, 1978)

Tvcb **Basalt flows and breccia**—Several thin basalt flows and minor associated flow breccia that overlie the main deposits of the Canjilon tuff. Shallow bowl shape of flows attributed to gravitational sagging above the volcanic center following eruption (Kelley and Kudo, 1978). Maximum thickness less than 60 ft

Tbj **Basalt of Mesita de Juana (upper Pliocene)**—Dark-gray, vesicular, holocrystalline basalt. Phenocrysts include labradorite, olivine, augite, and minor magnetite. Unit crops out only at north edge of quadrangle west of Cerrillos Hills. Thickness about 30 ft

Tbd **Benevidez diatreme deposits (Miocene)**—Basaltic tuff and tuff breccia intruded into Santa Fe Group sediments. Deposit forms the eroded relic of a maar or tuff cone in western part of quadrangle. Basaltic materials enclose considerable gravel and sand incorporated from the surrounding sediments (description based on Kelley and Kudo, 1978)

Tdc **Dacite of Cerro Colorado (Miocene)**—Dacite plug intruded into trachytic lavas and pyroclastic deposits that are interbedded with Santa Fe Group sediments. Intrusion located just south of Interstate 40 near west edge of quadrangle (description based on Wright, 1946)

Tbn **Basalt of La Mesita Negra (Miocene)**—Tilted relic of a flow or sill within fine-grained beds of the Santa Fe Group, just north of Interstate 40 near west edge of quadrangle (description based on Kelley and Kudo, 1978)

Tbb **Basalt flows (upper Oligocene)**—Basalt interbedded with lower part of the Tanos Formation in Hagan Basin. Dated at 25.4 Ma (Connell and Cather, 2001)

Intrusive rocks of Ortiz porphyry belt

Tvt **Vent breccia and tuff (Oligocene)**—Lithic tuff containing abundant chips and blocks of Tertiary and Cretaceous sedimentary rocks and some igneous porphyries. Location probably marks one of the sources of the Espinaso Formation volcanic rocks

Tl **Latite porphyry (Oligocene)**—Light-gray to light-brown, feldspar-phyric latite with trachytic groundmass. Alkali feldspar phenocrysts 2–3 mm (2–3 cm in stock at Cunningham Gulch in Ortiz Mountains); groundmass contains hornblende and aegirine-augite. Typically forms stocks, plugs, and thick dikes

Tam **Augite monzonite (Oligocene)**—Gray to dark-gray, medium-grained, equigranular to slightly porphyritic monzonite. Rock appears spotted due to orthoclase rims on andesine phenocrysts and disseminated augite, in matrix of orthoclase and minor biotite. Forms stocks in Cerrillos Hills, Ortiz Mountains, and San Pedro Mountains intruded at about 28 Ma (Sauer, 2001)

Thm **Hornblende monzonite (Oligocene)**—Gray to dark-gray, medium-grained, equigranular to slightly porphyritic monzonite with phenocrysts of andesine and hornblende. Forms stocks in Cerrillos Hills and Lone Mountain intruded at about 28 Ma (Sauer, 2001)

Tqmd **Quartz-hornblende monzodiorite (Oligocene)**—Medium-gray to light-gray, hypidiomorphic-granular monzodiorite with plagioclase phenocrysts and interstitial quartz and hornblende. Forms a stock at Captain Davis Mountain and a smaller body several miles southwest. Similar small bodies throughout the Ortiz porphyry belt were intruded at about 36–33 Ma (Sauer, 2001)

Tap **Andesite porphyry (Oligocene)**—Grayish-green and gray intrusive rock that weathers olive green to brownish green. Contains phenocrysts of plagioclase, hornblende, and rare quartz in aphanitic groundmass. Forms laccoliths, dikes, sills, and irregular bodies throughout the Ortiz porphyry belt. Intruded prior to about 36 Ma based on cross-cutting relations (Sauer, 2001)

Tr **Rhyolite (Oligocene)**—White to light-brown, aphanitic to porphyritic rhyolite; phenocrysts consist of subhedral quartz and rare biotite. Forms sills and dikes in the San Pedro Mountains. Intruded prior to about 36 Ma based on cross-cutting relations (Sauer, 2001)

Proterozoic intrusive rocks

Ys **Sandia Granite (Middle Proterozoic)**—Pink and grayish-pink, very coarse grained biotite monzogranite to granodiorite porphyry. Microcline phenocrysts show igneous flow alignment. Rock contains elongate inclusions of microdiorite, fine-grained granite, and blocks of gabbro, as well as irregular xenoliths of metasedimentary and metavolcanic country rock. Intruded at about 1,446 Ma (D.M. Unruh, USGS, unpub. data cited in Karlstrom, 1999)

Yss **Sandia Granite, sheared**—Rock within broad northeast-trending zone shows protomylonitic fabric and rounded phenocrysts

Yfg **Fine-grained granite (Middle Proterozoic)**—Pale leucogranite, probably related to the Sandia Granite (Ys). Discordantly intrudes metavolcanic rocks in fault block near Monte Largo

Xg **Granite (Early Proterozoic)**—Gray and pinkish-gray, massive to foliated leucogranite, biotite granite, and biotite monzogranite. Includes granite in the Manzanita pluton (Karlstrom and others, 1994) and foliated granite (the Cibola Gneiss of Kelley and Northrop, 1975) intruded at about 1,645 Ma (Karlstrom, 1999)

Contact

Normal fault—Dashed where inferred from aeromagnetic data; dotted where covered by surficial deposits. Bar and ball on downthrown side

Thrust fault—Dotted where concealed. Sawtooth on upper plate

Reverse fault—Dotted where concealed. Box on upthrown side

Fold—Showing trace of axial surface, and plunge where known

Anticline

Syncline

Monocline

Overturned anticline

Overturned syncline

Dike

Felsic—North of Galisteo Creek

Mafic

Bedding in sedimentary rocks

Inclined

Overturned

Vertical

Horizontal

Inclined foliation in metamorphic rocks

Inclined flow foliation in intrusive rocks

Inclined cataclastic foliation in mylonite zones

GEOLOGIC MAP OF THE ALBUQUERQUE 30' x 60' QUADRANGLE, NORTH-CENTRAL NEW MEXICO

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