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Lexicon of rock-stratigraphic units in Union, Colfax, Mora, and eastern Taos Counties, New Mexico

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LEXICON OF ROCK-STRATIGRAPHIC UNITS IN UNION, COLFAX, MORA, AND EASTERN TAOS COUNTIES, NEW MEXICO

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INTRODUCTION

This lexicon includes rock-stratigraphic (lithostratigraphic) units and geologic names that have been applied to exposed rocks in Union, Colfax and Mora Counties, and the eastern part of Taos County. Due to limited space many well-known terms and place names are abbreviated (see list below), and informal and economic terms have been omitted. Cambrian and Ordovician sedimentary rocks occur in the subsurface of Union County; none are known from the subsurface of Colfax County (Foster, 1966 New Mexico Geological Society Guidebook, 17th Field Conference). The names applied to these lower Paleozoic rocks are from the Midcontinent area of the U.S. (Baldwin and Muehlberger, 1959, New Mexico Bureau of Mines and Mineral Resources Bulletin 63). Rocks from many other parts of the geologic column are either missing or unrecognized in the four counties. For these reasons, no formal names of Silurian, Devonian, Early and Middle Triassic, Early and Middle Jurassic, Eocene, or Oligocene rocks appear in this lexicon. However, a section approximately 9,500 ft thick (Johnson, Dixon, and Wanek, 1966, New Mexico Geological Society 17th Field Conference) thought to represent Eocene and Oligocene time is present in adjoining southeast Colorado.

A formal stratigraphic name is one that has been defined according to the Code of Stratigraphic Nomenclature (1970) and whose definition has appeared in a publication. Names in abstracts were not considered. Of course, many published names predate publication of the Code and do not have adequate definitions by modern standards. Ideally, each formal name should have as part of its definition the description of: 1) a type section, locality, or area, 2) lithology, 3) contacts with adjacent units, 4) areal distribution, and 5) age.

In this lexicon, the name, its stratigraphic rank, time-stratigraphic unit assignment, and areal extent are given in that order in the heading for each unit. Citation of the naming paper, with a brief description of the stratigraphic unit from it, is followed by information from published references in which use of the unit was modified or clarified in some way in one or all four counties of the conference area. If the state name is omitted after the location of the type or derivation of the geographic name, the locality is within New Mexico. Information in most of the naming papers written before and shortly after 1900 was abstracted from the Wilmarth Lexicon (U.S. Geol. Survey Bulletin 896); the other information was abstracted from original sources. Some of the stratigraphic units described in this lexicon have not been adopted by the U.S. Geological Survey. The initial letters of all formal units are capitalized.

ABBREVIATIONS

Because of space limitations: 1) all state name abbreviations follow the U.S. Postal Service usage; 2) none of the authors' first names is written out or shown by initials; 3) no metric conversions are given; 4) all stratigraphic sequences are listed within each reference in order of decreasing age; 5) punctuation is minimal, included only when confusion may exist.

The common abbreviations used are:

Lithological Terms

aren—arenaceous
argill—argillaceous
ark—arkose, arkosic
calc—calcareous
carbonac—carbonaceous
cgl—conglomerate
cgltic—conglomeratic
clyst—claystone
dol—dolomite, dolomitic
gyp—gypsum
gypsif—gypsiferous
ls—limestone
mdst—mudstone
ss—sandstone
sdy—sandy
sh—shale
sltst—siltstone

Miscellaneous

amt—amount
approx—approximate, approximately
avg—average
Co—County
conf—conformable
disconf—disconformable
equiv—equivalent
ft—feet
fossil if—fossiliferous
loc—locality
mi—miles
mtns—mountains
m y—millions of years
no—number
p—page
pt—part
R—river
rept—report
sec—section
unconf—unconformable, unconformity
v—volume
yr—year

Publications

AAPG—American Association of Petroleum Geologists Bulletin
AJS—American Journal of Science
GSA—Geological Society of America Bulletin
IGC—International Geological Congress
JG—Journal of Geology
KGS—Kansas Geological Survey Bulletin
NMBB—New Mexico Bureau Mines and Mineral Resources Bulletin
NMBC—New Mexico Bureau Mines and Mineral Resources Circular
NMBG—New Mexico Bureau Mines and Mineral Resources Groundwater Report
NMBM—New Mexico Bureau Mines and Mineral Resources Memoir
NMGS FC—New Mexico Geological Society Field Conference
USGSA—U.S. Geological Survey Annual Report
USGSB—U.S. Geological Survey Bulletin
USGSI—U.S. Geological Survey I Map
USGSOM—U.S. Geological Survey Oil and Gas Map
USGSPM—U.S. Geological Survey Preliminary Map
USGSP—U.S. Geological Survey Professional Paper
USGSW—U.S. Geological Survey Water-Supply Paper

Stratigraphic Rank

Fm—Formation
Gp—Group
Mbr—Member
Ser—Series
Sys—System

ROCK-STRATIGRAPHIC UNITS

ALAMITOS FM—middle and upper Pennsylvanian (Desmoinesian to Virgilian)—North-central NM

Sutherland, 1963 (NMBM 11, p 36-38). Ark and ls. Replaces upper ark ls mbr of Madera. Overlies La Pasada Fm in S and Flechado Fm in N; underlies Sangre de Cristo Fm. Type sec in Alamitos Canyon, 1.1 mi W of town of Pecos, San Miguel Co., where it is 1,000+ ft thick.

AMALIA FM—upper and middle Tertiary Sys—NM

McKinlay, 1956 (NMBB 42, p 16-18). Interbedded ark, basalt flows, and rhyolite tuffs. About 2,000 ft thick. Overlies andesite and andesite tuffs; locally underlies Tert. and Quat. basalt flows or Tert. gravels. Named for Amalia P.O. on W side Costilla Valley, 5 mi SE of town of Costilla, Taos Co.

ARROYO PENASCO GP—Lower and Upper Mississippian Ser—North-central NM

Armstrong, 1955 (NMBC 39, p 3). Gray, dense, fine-grained to oolitic, massive- to medium-bedded ls of fm rank. 20-150 ft thick. Overlies Precamb. gneiss; underlies Penn. Log Springs Fm. Named for Arroyo Peñasco, at type sec, sec 5, T 16 N, R 1 E, Sandoval Co.

Armstrong and Mamet, 1974 (NMGS 25th FC, p 146-151). Raised to gp rank. Two fms, Espiritu Santo and Tererro. Osagean to Chesterian in age.

ARTESIA FM, GP—Lower and Upper Permian (Guadalupian) Ser—East NM, West TX

Tait and others, 1962 (AAPG v 46, no 4, p 504-517). Carbonate, evaporite, and clastic shelf rocks named Artesia Gp. Replaces prior use of Whitehorse Gp, Chalk Bluff and Bernal Fms. Of gp rank in SE NM and W TX where divisible into: Tansill, Yates, Seven Rivers, Queen, and Grayburg Fms. In NE NM overlies San Andres Ls and underlies Santa Rosa Ss. Named for city of Artesia and Artesia field in T 18 S, R 28 E, Eddy Co. Reference well: Humble Federal Bogle No 1, sec 30, T 16 S, R 30 E, where 1,710 ft thick.

Mourant, 1963 (NM State Engineer Technical Rept 28, p 15, 24). Locally of fm rank.

BALDY HILL FM—Dockum Gp—Upper Triassic Ser—Northeast NM

Baldwin and Muehlberger, 1959 (NMBB 63, p 37-38). Silty mdst with beds of ledge-forming sdy mdst and very fine-grained ss; generally purple which mottles orange, gray red, light to medium gray, and olive. 115 ft thick. Oldest fm exposed in Union Co. Underlies Travesser Fm. Named for Baldy Hill, sec 36, T 32 N, R 32 E, Union Co.

BELL RANCH FM—San Rafael Gp—Upper Jurassic Ser—Northeast NM

Griggs and Read, 1959 (AAPG 43, p 2006). Alternating sequence of light gray ss and brownish-red sltst with small gyp nodules. Near CO state boundary gyp beds in sltst. Replaces Wanakah, a term restricted to SW CO. Overlies Entrada Ss; underlies Morrison Fm. At type sec 18 mi SE of Bell Ranch headquarters, San Miguel Co., fm is 66 ft thick.

BENTON FM, GP—Lower and Upper Cretaceous Ser—MT and SD to NM

Meek and Hayden, 1862 (Philadelphia Acad Nat Sci Proc v 13, p 140, 421). Dark gray laminated clays with seams and layers of soft gray ls. Named for Fort Benton, on Missouri R, MT where it is 800 ft thick.

Bachman, 1953 (USGSOM 137). Benton Fm: brown marine sh (Graneros =); gray, thin-bedded ls (Greenhorn =); and brown to gray marine sh (Carlile =) [Mora Co] .

Baldwin and Muehlberger, 1959 (NMBB 63, p 58-59). Graneros Sh, Greenhorn Ls, and Carlile Sh of Benton Gp. Overlies Dakota Gp; underlies Niobrara Fm. [Union Co] .

BERNAL FM—Permian Sys—Northeast NM

Bachman, 1953 (USGSOM 137). Brownish-red sltst and fine-grained ss. Avgs 100 ft thick. Formerly upper clastic mbr of San Andres Ls. Disconf overlies Glorieta Ss; disconf underlies Santa Rosa Ss. Type sequence near villages of Bernal and Chapelle, San Miguel Co.

Tait and others, 1962 (AAPG v 46, no 4, p 511). 165 ft at type sec. Equiv to lower half of Artesia Gp or Fm which replaces name Bernal locally.

BLUE HILL SH MBR—Carlile Fm—Upper Cretaceous Ser—KS, CO, NM

Logan, 1897 (KS Univ. Geol. Survey v 2, p 218, 225, 228, 229). Dark-blue sh 100 ft thick. Called Blue Hills Shs. Named for Blue Hills, KS

Pillmore, 1976 (this Guidebook). 137 ft of sh with ls concretions. Overlies Fairport Mbr; underlies Juana Lopez Mbr. Extended to Colfax Co.

BRIDGE CREEK LS MBR—Greenhorn Fm—Upper Cretaceous Ser—KS, CO, NM

Bass, 1926 (KGS 11, p 97). Limy sh and chalky ls. 74 ft thick. Top mbr of Greenhorn Ls. Overlies Hartland Sh Mbr; underlies Fairport Mbr of Carlile. Named for exposures on Bridge Creek, KS.

Pillmore, 1976 (this Guidebook). 16 ft of gray ls and interbeds of shaly ls, calcareous sh, and bentonite. Extended to Colfax Co.

CABRESTO METAQUARTZITE—Precambrian Sys—NM

McKinlay, 1956. (NMBB 42, p 8-10). Gray to cream quartzite and 2-10 ft layers of coarsely crystalline glossy to milky-white quartz. Massive layers contain scattered muscovite flakes, and are separated by thin muscovite and biotite-magnetite-garnet

bands. Locally contains gneiss layers. 200 to 1,000+ ft thick. Named for exposures in Cabresto Canyon, Taos Co., S edge Costilla quad.

CAPULIN BASALT (BASALTS)—Holocene Ser—Northeast NM

Collins, 1949 (GSA v 60, p 1023). Dark-gray to black vesicular and scoriaceous olivine basalt. 5-25 ft thick. Named for scoria cone and associated flows at Mount Capulin, Union Co.

Baldwin and Muehlberger, 1959 (NMBB 63, p 126-132). Basalt flows and cinder cones called Folsom Vents Basalt, Capulin Mountain Basalt, Twin Mountain cinder cone, Purvine Hills vents and Baby Capulin Basalt are all parts of the Capulin Basalts. Stormer, 1972 (GSA v 83, p 2443-2448). K/Ar dates of 4,000-10,000 yrs old.

CARLI LE SH, FM—Benton Gp, Colorado Gp—Upper Cretaceious Ser—MT and ND to NM

Gilbert, 1896 (USGSA 17th, pt 2, p 565). Gray sh with ls and ss at top. 175-200 ft thick. Overlies Greenhorn Ls; underlies Timpas Ls [Fort Hays Ls Mbr, Niobrara Fm] . Named for Carlile Spring and Carlile Station, 21 mi W of Pueblo, CO.

Rankin, 1944 (NMBB 20, p 7, 11-13, figs. 3, 4, 5). Of Colorado Gp. Divided into: sh mbr, Juana Lopez Ss Mbr, sh mbr, and Codell Ss Mbr.

Baldwin and Muehlberger, 1959 (NMBB 63, p 62-63). Top fm of Benton Gp.

Pillmore, 1976 (this Guidebook). Fairport, Blue Hill Sh, and Juana Lopez Mbrs, and upper black sh unit of Carlile Fm extended to Colfax Co. 252 ft thick.

CHICO PHONOLITES—Quaternary Sys—Northeast NM

Collins, 1949 (GSA v 60, p 1023). Phonolite flows. Named for exposures near township of Chico, Colfax Co.

Muehlberger, 1959 (IGC, 20th Mexico, Sec XI-A, p 228). May be part of long sequence of eruptions which also include Red Mountain Dacites, Slagle Trachytes and Clayton Basalts.

CHIN LE FM—Dockum Gp—Upper Triassic Ser—AZ, UT, CO, NM

Gregory, 1916 (USGSW 380). Consists of brown Oren shs; purple, lavender, green, and variegated shs with cgl lenses; lenses of ls cgl containing red sh; red sh and shly ss. 400-1,000 ft thick. Overlies Shinarump Cgl; underlies unconf(?) Wingate Ss. Named for Chinle Valley, AZ.

Bachman, 1953 (USGSOM 137). Brownish-red and maroon sh and sltst. 640 ft thick. Upper fm of Dockum Gp in Colfax Co. Overlies Santa Rosa Ss; underlies Naranjo Fm.

Baldwin and Muehlberger, 1959 (NMBB 63, p 34-42). Chinle not used in Union Co. Dockum divided into: Baldy Hill, Travesser, Sloan Canyon, and Sheep Pen Fms.

CLAYTON BASALT (BASALTS)—Pliocene Ser—East NM

Collins, 1949 (GSA v 60, p 1023). Predominantly medium gray to black olivine basalt. Named for Folsom-Clayton Mesa near Clayton.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Flows are 50-500 ft above adjacent valley floors. Avg 20 ft thick.

Baldwin and Muehlberger, 1959 (NMBB 63, p 115-126). Emery Peak Basalt, East Emery Peak Basalt, augite vents, Purvine Mesa Basalt, Mud Hill-Great Wall, Bellisle Mountain, Robinson Mountain Basalt, and Jose Butte Basalt of the Folsom sequence are pts of the Clayton Basalt. Three basalts of unknown stratigraphic position may also be part of the Clayton.

Stormer, 1972 (GSA v 83, p 2443-2448). K/Ar age of 2.5±0.8 m y and 2.2±0.3 m y.

CODELL SS MBR—Carlile Sh—Upper Cretaceous Ser—KS, NE, SD, CO

Bass, 1926 (KGS 11, p 28, 64). Codell Ss Bed, sandy zone 20-25 ft thick at top of Blue Hill Sh Mbr, Carlile Sh. Named for exposures in bluffs along Saline Valley, KS, 5 mi S and W of Codell, KS.

Rankin, 1944 (NMBB 20, p 7). Codell Ss Mbr, topmost mbr of Carlile Sh. Overlies sh mbr; underlies Niobrara Fm.

Griggs, 1948 (NMBG 1, p 29-30). Facies equiv may be present in Colfax Co.

COLORADO GP—Lower and Upper Cretaceous Ser—MT and ND to NM

Hayden, 1876 (U.S. Geol & Geog Survey of the Terr 8th Ann Rept, p 45). Includes Fort Benton [Benton], Niobrara, and Fort Pierre [Pierre] units. Overlies Dakota Gp; underlies Fox Hills Fm. Named for exposures along east base of Front or Colorado Range, CO.

Harley, 1940 (NMBB 15, p 24-25). Includes Benton and Niobrara Fms or rocks between base of Graneros Sh and top of Niobrara Fm.

COWLES MBR—Tererro Fm, Arroyo Peñasco Gp—Upper Mississippian Ser—North-central NM

Baltz and Read, 1060 (AAPG v 44, p 1763-1765). Light grayish-yellow to olive-yellow, cross-bedded, silty calcarenite and calc sltst. Unconf overlies Manuelitas Mbr; unconf underlies Sandia Fm. Named for exposures in canyon of Pecos R near Cowles, San Miguel Co. Type loc is abandoned quarry on road to Winsor Ranch about 0.2 mi above junction with N.M. 63 (junction is about 1.4 mi S of Cowles), where it is 57 ft thick.

Armstrong and Mamet, 1974 (NMGS 25th FC, p 146-150). Siltsts, shs, pelletoidal fine-grained silty lss, and fine-grained ostracod mdst. Only present in Sangre de Cristo Mtns. Chesterian in age. Tererro assigned to Arroyo Peñasco Gp.

DAKOTA SS, GP—Upper Cretaceous Ser—MT and ND to NM

Meek and Hayden, 1862 (Philadelphia Acad Nat Sci Proc, v 13, p 419-420). Dakota Gp (Formation No 1 of Cret.) yellowish,

reddish, white ss with alternations of various-colored clays and lignite. 400 ft thick. Occurs in hills back of town of Dakota and extensively developed in Dakota Co, NE.

Griggs, 1948 (NMBG 1, p 22-24). Includes all ss (fine- to medium-grained) between Morrison Fm and Graneros Sh. Up to 220 ft thick.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Fine- to medium-grained, medium- to thick-bedded, parallel-bedded, quartzose buff, brown or red-brown ss. Some lenses coarse to very coarse quartz and small pebbles of chert and quartz scattered through ss. Conf overlies Purgatoire Fm.

Baldwin and Muehlberger, 1959 (NMBB 63, p 51-58). Dakota Gp includes Purgatoire and Dakota Fms. Overlies Morrison Fm; underlies Graneros Sh.

Dinwiddie and Cooper, 1966 (NMGS 17th FC, p 77). Dakota and Purgatoire Fms difficult to separate. Term Dakota Ss applied to all ss and minor amt of sh between Morrison Fm and Graneros Sh.

Clark and Read, 1972 (NMBB 94, p 48-49). Well-developed ledges of gray- or buff-weathering ss. A lower ledge may be the Purgatoire.

DEL PADRE SS MBR—Espiritu Santo Fm, Arroyo Peñasco Gp—Lower Mississippian Ser—North-central NM

Sutherland, 1963 (NMBM 11, p 20-25). Unfossilif, orthoquartzitic ss of fm rank and undetermined age. Basal pt of Espiritu Santo Fm of Baltz and Read (1960). Variable thickness; up to 754 ft. Underlies and probably interfingers with Espiritu Santo Fm. Named for Del Padre buff; type loc N side Rito del Plato at its junction with the Pecos R., Mora Co.

Clark and Read, 1972 (NMBB 94, fig 6). Basal mbr of Espiritu Santo Fm.

Armstrong and Mamet, 1974 (NMGS 25th FC, p 146-149). Espiritu Santo assigned to Arroyo Peñasco Gp of Osagean age.

DOCKUM GP—Upper Triassic Ser—TX, NM, CO

Cummins, 1890 (TX Geol Survey 1st Ann Rept, p 189). Cgl, ss, and red clay. 150 ft thick. Unconf overlies Upper Perm. ss and clay; underlies Blanco Fm. Named for Dockum, Dickens Co, TX.

Parker, 1933 (JG v 41, p 41). Dockum Gp underlies Sloan Canyon Fm in Union Co.

McLaughlin, 1954 (USGSW 1256, p 82-83). Dockum Gp used for all Trias. rocks in Union Co.

Bachman, 1953 (USGSOM 137). Santa Rosa Ss and Chinle Fm separated in Ocate area, Mora Co.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). In Colfax Co Dockum Gp not divided. Santa Rosa Ss and Chinle Fm thought to be present.

Baldwin and Muehlberger, 1959 (NMBB 63, p 34-42). Dockum includes all Trias. rocks in Union Co; is 907 ft thick; and is divided into: Baldy Hill, Travesser, Sloan Canyon, and Sheep Pen Fms.

EMBUDO GRANITE—Precambrian Sys—North-central NM

Montgomery, 1953 (NMBB 30, p 37-46). Several distinct rock types—especially biotite granite, gneissic granite, and leucogranite. Invaded all rocks of the Ortega and Vadito Fms. Replaces name Dixon Granite of Just, 1934. Named for town of Embudo, Rio Arriba Co, 4 mi W of extensive outcrops of the granite.

Fullager and Shiver, 1973 (GSA v 84, p 2707). Rb/Sr date of 1,673 m y.

ENTRADA SS—San Rafael Gp—Upper Jurassic Ser—UT, CO, NM, AZ

Gilluly and Reeside, 1926 (USGS Press Bull. 6064); Gilluly and Reeside, 1928 (USGSP 150-D, p 76). Thin-bedded red sh and ss at base becoming massive red-brown earthy ss. Conf overlies Carmel Fm; unconf underlies Curtis Fm. Named for Entrada Point, north pt of San Rafael Swell, UT.

Dinwiddie and Cooper, 1966 (NMGS 17th FC, p 76). Massive white to pink and buff, poorly cemented ss. up to 80 ft thick. Overlies Dockum Gp; underlies Morrison Fm.

ESPIRITU SANTO FM—Arroyo Peñasco Gp—Lower Mississippian Ser—North-central NM

Baltz and Read, 1960 (AAPG v 44, p 1752-1759). Basal buff, gray, or brown ss succeeded by gray to brownish-gray sdy dol ls, ls with banded chert, and silty sdy ls. Formerly lower pt of lower ls mbr of Sandia Fm. Unconf on Precamb. unconf overlain by Miss. units. Named for exposures near confluence of Holy Ghost Creek (formerly called Espiritu Santo Creek) and Pecos R at Tererro, San Miguel Co where it is 30+ ft thick.

Sutherland, 1963 (NMBM 11, p 23-27). Basal ss of Baltz and Read assigned to Del Padre Ss. Espiritu Santo restricted to ls and dol.

Clark and Read, 1972 (NMBB 94, Fig 6). Del Padre Ss Mbr (6 in to 10 ft thick) is basal mbr of Espiritu Santo.

Armstrong and Mamet, 1974 (NMGS 25th FC, p 145-148). Osagean age. Assigned to Arroyo Peñasco Gp.

EXETER SS—Upper Jurassic Ser—Union Co, NM and Cimarron Co, OK

Lee, 1902 (JG v 10, p 45-46). Pink to white, coarse even-laminated ss 75 ft thick. Overlies red beds; underlies Morrison Fm. Named for Exeter P.O., Union Co.

Johnson, 1959 (USGSB 1071-D, p 94-95). Replaced by Entrada Ss in SE CO and NE NM.

USGS in 1969 limited use of Exeter to two counties noted in heading.

FAIRPORT MBR—Carlile Fm—Upper Cretaceous Ser—KS, CO, NM

Rubey and Bass, 1925 (KGS 10, p 16, 40). Chalky sh and chalk, 85 ft thick. Overlies Greenhorn Ls; underlies Blue Hill Sh. Named for exposures S and W of Fairport, KS.

Pillmore, 1976 (this Guidebook). Calc gray sh 32 ft thick. Overlies Niobrara Fm; underlies Blue Hill Sh. Extended to Colfax Co.

FLECHADO FM—lower and middle Pennsylvanian (Morrowan to Desmoinesian)—North-central NM

Sutherland, 1963 (NMBM 11, p 33-36). Ss of low (< 3%) feldspar content, cgl, sh, some massive dark-gray ls. Unconf overlies Miss. rocks; underlies Alamitos Fm. Approx northern equiv of La Pasada Fm. Name from creek E of Gallegos Creek; type sec 3 mi E of junction of N.M. Hgwy. 3 and 75, Taos Co.

FORT HAYS LS MBR—Niobrara Fm—Upper Cretaceous Ser—NE, KS, CO, NM

Williston, 1893 (KS Acad Sci Trans v 13, p 108-109). Chalk or soft white ls at base of Niobrara Fm. About 80 ft thick. Named for Fort Hays, KS.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Light- to dark-gray finely crystalline and sublithographic ls beds 1 to 1.5 ft thick. Mbr avgs 15-30 ft thick. Overlies Carlile Sh; underlies Smoky Hill Marl.

GLORIETA SS—Lower Permian (Leonardian) Ser—NM

Keyes, 1915 (10 Acad Sci Proc v 22, p 257, 262; Conspectus of geol. fms of NM, p 2, 7). 300 ft thick main body of Dakotan series (Cret.) around S end of Rocky Mtns called "Glorieta" Sss.

Hager and Robitaille, 1919 (unpub. geol. rept on oil possibilities in eastern NM). Top mbr of Yeso. 500 ft massive white (weathers reddish-brown) ss.

Needham and Bates, 1943 (GSA v 54, p 1662-1664). Glorieta Ss of fm rank. Type sec designated in south-central pt of T 15 N, R 12 E, San Miguel Co. Overlies Yeso Fm; underlies San Andres Ls.

Read and Andrews, 1944 (USGSPM 8). Basal mbr of San Andres Ls.

Bates, Wilpolt, MacAlpin, and Vorbe, 1947 (NMBB 26, p 32). Although USGS classifies Glorieta as a mbr of the San Andres, the NM Bureau of Mines and Mineral Resources considers it a fm.

Bachman, 1953 (USGSOM 137). Basal mbr of San Andres; overlies Yeso Fm and underlies Bernal Fm.

Bachman and Dane, 1962 (USGSI 358). Of fm rank.

GRANEROS SH—Benton Gp, Colorado Gp—Upper and Lower Cretaceous Ser—WY and SD to NM

Gilbert, 1896 (USGSA 17th pt 2, p 564). Laminated argil! or clayey gray shs with limy and sandy material. About 200 ft thick. Overlies Dakota Ss; underlies Greenhorn Ls. Named for Graneros Creek, CO.

Rankin, 1944 (NMBB 20, p 5). Basal fm of Colorado Gp.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Dark gray to black, noncalc, fossilif sh. Several bentonite beds; scattered gyp crystals. Brown-gray finely crystalline ls beds locally. Avgs 160 ft thick.

Baldwin and Muehlberger, 1959 (NMBB 63, p 58-59). Basal fm of Benton Gp.

GREENHORN LS, FM—Benton Gp, Colorado Gp—Upper Cretaceous Ser—MT and ND to NM

Gilbert, 1896 (USGSA 17th pt 2, p 564). Ls 25-40 ft thick. Overlies Graneros Sh; underlies Carlile Sh. Named for Greenhorn Station 14 mi S of Pueblo, CO.

Rankin, 1944 (NMBB 20, p 5). Of Colorado Gp.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Gray to black, finely crystalline, argill ls. Sh intervals are gray to black, silty, calcareous, limonitic. Locally thin bentonite beds. Avgs 35 ft thick.

Baldwin and Muehlberger, 1959 (NMBB 63, p 59, 62). Middle fm of Benton Gp.

Pillmore, 1976 (this Guidebook). Lincoln, Hartland, and Bridge Creek Ls Mbrs of Greenhorn Fm extended to Colfax Co. 130 ft thick.

HARTLAND MBR—Greenhorn Fm—Upper Cretaceous Ser—KS, CO, NM

Bass, 1926 (KGS 11, p 203). Chalky sh with a few thin chalky ls beds. 28-40 ft thick. Called Hartland Sh Mbr, Greenhorn Ls. Overlies Lincoln Ls Mbr; underlies Jetmore Chalk Mbr. Named for exposures W of Hartland, KS.

Pillmore, 1976 (this Guidebook). 52 ft thick dark-gray calcareous sh. Bentonite beds in upper and lower pts. Underlies Bridge Creek Mbr; overlies Lincoln Mbr. Extended to Colfax Co. 130 ft thick.

JOHNSON GAP FM—Upper Triassic Ser—Southeast CO, NM

Johnson and Baltz, 1960 (AAPG v 44, p 1897-1898). Thin to thick beds of gray silty siliceous ls cgl containing pebbles and cobbles of gray finely crystalline ls. Correlated with beds assigned to Dockum Gp. Overlies Sangre de Cristo Fm; underlies Entrada Ss. Named for Johnson Gap; type sec, secs 19 and 20, T 34 S, R 69 W, Las Animas Co, CO where it is 90 ft thick Thickens S to 100 ft at state line and 110 ft in NM.

Pillmore, 1976 (this Guidebook). Age changed to Late Triassic.

JUANA LOPEZ MBR—Carlile Fm—Upper Cretaceous Ser—NM, CO

Rankin, 1944 (NMBB 20, p 7, 12). Calc ss near top of Carlile Sh. Type sec, sec 32, T 15 N, R 7 E on Mesita Juana Lopez Grant, Santa Fe Co, where it is 10 ft thick.

Pillmore, 1976 (this Guidebook). Extended to Colfax Co. Black calcareous sh and calcarenite 25 ft thick. Overlies Blue Hill Mbr and underlies upper black shale unit, both of Carlile Fm.

LA PASADA FM—lower to middle Pennsylvanian (Morrowan to middle Desmoinesian)—North-central NM

Sutherland, 1966 (NMBM 11, p 30-33). Cyclic carbonate with ss and cgl at base, sh and sltst interbedded with ls in upper pt. Replaces Sandia Fm and lower gray ls mbr of Madera Fm. Unconf overlies Miss. rocks; underlies Alamitos Fm; approx

southern equiv of Flechado. Named for Upper La Pasada near the foot of Dalton Bluff on W side Pecos Valley. At type loc at Dalton Bluff, San Miguel Co, is 973 ft thick; thickens to N.

LAS FEVERAS FM—lower Quaternary or upper Tertiary Sys—Northern NM

Bachman, 1953 (USGSOM 137). Brownish-red alluvium and gravel. 150+ ft thick. Overlies Sangre de Cristo Fm; underlies Quat. basalt flow. Named for Las Feveras Canyon which drains NW pt of Ocate Valley, Mora Co.

LATIR PEAK LATITE—Tertiary Sys—Northern NM

McKinlay, 1956 (NMBB 42, p 14). Occurs as flows, sills, and dikes. Light gray to red and porphyritic. Intruded between older andesite tuffs and sediments, and younger rhyolite tuffs. Named for Latir Peak, Taos Co.

LINCOLN MBR—Greenhorn Fm—Upper Cretaceous Ser—KS, CO, NM

Logan, 1897 (KS Univ Geol Survey v 2, p 216). Gray ls intercalated with sh near base of Benton Fm, called Lincoln Ls. Named for Lincoln, KS.

Pillmore, 1976 (this Guidebook). Calc and noncalc sh 137 ft thick. Overlies Graneros Sh; underlies Hartland Mbr. Extended to Colfax Co.

MACHO MBR—Tererro Fm, Arroyo Peñasco Gp—Upper Mississippian Ser—North-central NM

Baltz and Read, 1960 (AAPG v 44, p 1759-1760). Massive, ledge-forming ls breccia, the lower 30 ft of Tererro Fm. Unconf overlies Espiritu Santo Fm; unconf underlies Manuelitas Mbr. Named for exposures NW of confluence of Macho Creek, 5.3 mi S of Tererro, San Miguel Co.

Armstrong and Mamet, 1974 (NMGS 25th FC, p 148-150). Of Meramecian age. Underlies Turquillo Mbr. Tererro Fm assigned to Arroyo Pefiasco Gp.

MADERA LS, FM—Magdalena Gp—middle to upper Pennsylvanian (Atokan to Virgilian)—NM

Keyes, 1902 (Ores and Metals v 12, p 48). Upper Carb. blue to gray beds, superior pt of great ls. Overlies middle Carb. lss. Named for town of La Madera, Sandoval Co.

Thompson, 1942 (NMBB 17, p 22). Proposed that term be dropped from Penn. of NM because it was poorly defined by Keyes, and used in so many different senses by him and by others.

Baltz and Bachman, 1956 (NMGS 7th FC, p 99-100). Lower gray ls mbr—thin- to thick-bedded crystalline granular fossilif ls interbedded with black sh, sltst, and ss. Ls dominant in south; black sh in north. Up to 400 ft thick in S; to 3,000+ ft in N. Upper ark ls mbr—gray and olive sltst, sh, fossilif ls, and coarse-grained cgltic ark ss. Fm overlies Sandia Fm; underlies Sangre de Cristo Fm.

MAGDALENA GP—Pennsylvanian Sys., Lower Permian Ser—NM, TX

Gordon, 1907 (J G v 15, p 807-816). Divided into: Sandia Fm (500-700 ft blue to black clay sh, ls, cgl, ss or quartzite) and Madera Ls (300-700 ft dark blue ls). Overlies Miss. rocks. Named for Magdalena Mtns, Socorro Co.

Bachman, 1953 (USGSOM 137). Gp undivided. More than 10,000 ft thick in foothills. Dominantly marine 1) ss and ark with sh and ls, 2) bituminous calcareous friable sh, 3) ark ss, sh, ls, 4) brown and brown-red ss, ark, sh with thin marine ls. Underlies Sangre de Cristo Fm.

Sutherland, 1963 (NMBM 11, p 29-30). Magdalena Gp not used because it is synonymous with Penn. Sys. Terms La Pasada, Flechado, and Alamitos defined to replace Magdalena Gp, and Sandia and Madera Fms.

Clark and Read, 1972 (NMBB 94, p 31). Term Magdalena Gp retained for Penn. rocks deposited before Sangre de Cristo Fm and after Tererro Fm.

MANUELITAS MBR—Tererro Fm, Arroyo Peñasco Gp—Upper Mississippian Ser—North-central NM

Baltz and Read, 1960 (AAPG v 44, p 1762-1763). Light- to medium-gray, fine- to coarse-grained calcarenite, ls pebble cgl, and finely crystalline ls. Unconf on Macho Mbr; unconf underlies Cowles Mbr. Named for exposures at W end of gap 1.6 mi east of Rociada, San Miguel Co. where Manuelitas Creek flows E into a broad canyon; here it is 45 ft thick.

Armstrong and Mamet, 1974 (NMGS 25th FC, p 147-150). Thick-bedded oolitic-bothrolitic grainstone and a silty, pelletoidal, fine-grained grainstone-packstone with minor calc silts. Overlies Espiritu Santo Fm, or Macho or Turquillo Mbrs of Tererro Fm of Arroyo Peñasco Gp. Meramecian in age.

MESA RICA SS—Lower Cretaceous Ser—NM

Dobrovolny and Summerson, 1946 (USGSPM 62). White or brownish-buff cross-bedded medium- or coarse-grained, massive or cliff-forming ss. Locally quartz-pebble cgl at base. Overlies Tucumcari Sh Mbr and underlies Pajarito Sh Mbr, both of Purgatoire Fm. [Derivation of name not given) .

Griggs and Read, 1959 (AAPG v 43, p 2007). Raised to fm rank. Purgatoire Fm abandoned in Tucumcari-Sabinoso area.

Wanek, 1962 (USGSOM 208). Avg 90 ft thick. Disconf overlies Morrison Fm.; conf underlies and intertongues with Pajarito Sh.

MONTANA GP—Upper Cretaceous Ser—Mt and ND to NM

Eldridge, 1888 (CO Sci Soc Proc v 3, pt 1, p 93). Sss and shs between Colorado Gp and Lance Fm. Named for extensive development in MT especially in Upper Missouri R region.

Levings, 1951 (CO School of Mines Quarterly v 46, no 3, p 16). Name used in NE NM to include Pierre Sh, Trinidad Ss and Vermejo Fm.

Gill and Cobban, 1973 (USGSP 776, p 12). Montana Gp restricted to central MT.

MORRISON FM—Upper Jurassic Ser—CO, NM, AZ, UT, WY, SD, MT, OK, KS

Eldridge, 1896 (USGS Monograph 27). Fresh-water marls, ls, and ss. About 200 ft thick. Overlain by Dakota Ss. Named for exposures at town of Morrison, CO.

Bachman, 1953 (USGSOM 137). Gray to brown, thin-bedded, fine- and medium-grained ss and brown to variegated sh 150 ft thick. Overlies Wanakah Fm; underlies Dakota Gp.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). About 345 ft thick in E Colfax Co.

Dinwiddie and Cooper, 1966 (NMGS, 17th FC, p 76). Overlies Entrada Ss; underlies Dakota Gp. Up to 550 ft thick.

NARANJO FM—Triassic Sys—Northeast NM

Bachman, 1953 (USGSOM 137). Interbedded brownish-red ss, sltst, and sh. 640 ft thick at type sec. Conf overlies Chinle Fm; disconf underlies Ocate Ss. Jurassic age based on correlation with pt of Glen Canyon Gp. Named for beds in a cutbank near village of Naranjo, about 2 mi E of Ocate, Mora Co.

Griggs and Northrop, 1956 (NMGS, 7th FC, p 134-135). Age changed to Trias. on basis of possible correlation with Sheep Pen Ss and Redonda Mbr of Chinle Fm.

NIOBRARA FM—Colorado Gp—Upper Cretaceous Ser—NE, WY, CO, NM, SD, ND, MT, KS

Meek and Hayden, 1862 (Philadelphia Acad Nat Sci Proc v 13, p 419, 422). Fm No 3 of Cret.; lower pt: yellow and white ls; upper pt: lead-gray calcareous marl. 200 ft thick. Overlies Fort Benton Gp [Benton] ; underlies Fort Pierre Gp [Pierre] . Named for exposures along Missouri R near mouth of Niobrara R, Knox Co, NE.

Griggs, 1948 (NMBG 1, p 30-33). Includes basal 15-20 ft thick Fort Hays Ls Mbr and overlying 900 ft thick Smoky Marl Mbr. Overlies Carlile Sh; underlies Pierre Sh.

OCATE SS—Jurassic Sys—North and east NM

Bachman, 1953 (USGSOM 137). Gray, medium-bedded to massive cross-laminated ss. Ferruginous stains and calcite veins common. About 50 ft thick. Overlies Naranjo Fm; underlies Wanakah Fm. Named for exposures on Ocate Creek about 1.5 mi E of Ocate, Mora Co.

Johnson, 1959 (USGSB 1071-D, p 94-5). Abandoned in favor of Entrada Fm.

OGALLALA FM—Miocene and Pliocene Ser—high plains of SD, NE, WY, KS, OK, NM, TX

Darton, 1899 (USGSA 19th pt 4, p 734-5; 741). Calc grit or soft ls and interbedded clay and sand, and a basal cgl at many localities. Pebbles of crystalline rocks from Rocky Mtns scattered through fm. Overlies Arikaree Fm; underlies Pliest. beds. 150-300 ft thick. Named for exposures near Ogallala, NE.

Griggs, 1948 (NMBG 1, p 35-36). Sand, silt, and clay. Gravel and boulders, principally at base. About 250 ft thick in SE Colfax Co.

ORTEGA FM—Precambrian Sys—North-central NM

Just, 1937 (NMBB 13, p 21). Quartzite and schist. Named Ortega Quartzite for Ortega Mountains, Rio Arriba Co.

Montgomery, 1953 (NMBB 30, p 6-21). Wholly metasedimentary rocks of Ortega Fm divided into: lower quartzite mbr, Rinconada Schist Mbr, and Pilar Phyllite Mbr. About 6,600 ft thick. Unconf underlies Vadito Fm.

PAJARITO SH—Lower Cretaceous Ser—NM

Dobrovolny and Summerson, 1946 (USGSPM 62). Brown ss alternating with gray sh. Upper mbr of Purgatoire Fm. Overlies Mesa Rica Ss Mbr [Derivation of name not given] .

Griggs and Read, 1959 (AAPG v 43, p 2007). Raised to fm rank. Purgatoire Fm abandoned in Tucumcari-Sabinoso area.

Wanek, 1962 (USGSOM 208). About 40 ft thick. Overlies and intertongues with Mesa Rica Ss; conf underlies and intertongues with Dakota Gp.

PICURIS BASALTS—Precambrian Sys—Northern NM

Just, 1937 (NMBB 13, p 23-24, 44). Basalt and andesite flows. Named for exposure in Picuris area near mouth of Picuris Canyon, W side Sangre de Cristo Mtns, Taos Co.

Gresens and Stensrud, 1974 (The Mtn Geol v. 11, p 109-124). Picuris name abandoned.

PICURIS TUFF—Miocene Ser—North-central NM

Cabot, 1938 (JG v 46, p 91). Buff water-laid tuff and gravel at base overlain in succession by sdy clay and gravel, cgl, gravel, basaltic lava, gravel. 1,200 ft thick. Unconf overlies Magdalena Gp; underlies Santa Fe Fm.

Montgomery, 1953 (NMBB 30, p 52-53). Of probable Miocene age.

Baldwin, 1958 (USGSW 1525, p 58). Equiv to Miocene Bishops Lodge Mbr, Tesuque Fm, Santa Fe Gp.

PIERRE SH—Upper Cretaceous Ser—ND to NM

Meek and Hayden, 1862 (Philadelphia Acad Nat Sci Proc v 13, p 419, 424). Dark-gray sh, fossilif, with veins and seams of gyp, masses of iron. About 700 ft thick. Overlies Niobrara division; underlies Fox Hills beds. Named for occurrence near Fort Pierre on the Missouri R, SD.

Lee, 1917 (USGSP 101, p 48). Name used in NE NM and modified to include "Lower Trinidad" of Hills (1899).

Johnson and Wood, 1956 (AAPG v 40, p 710). Dark gray to nearly black noncalc sh with thin zones of calc and iron carbonate

concretions. Upper 200-300 ft of buff to gray, thin-bedded, fine-grained ss with thin gray to dark-gray silty sh intertongues with overlying Trinidad Ss. About 1,600 ft thick.

Gill and Cobban, 1973 (USGSP 776, p 12). Removed from Montana Gp in NM because that gp restricted to central MT.

PI LAR PHYLLITE MBR—Ortega Fm—Precambrian Sys—North-central NM

Montgomery, 1953 (NMBB 30, p 6, 19-21). Replaces term Hondo Slate of Just (1937). Gray-black carbonaceous quartz-muscovite phyllite, 2,300 ft thick. Named for town of Pilar, Taos Co.

POISON CANYON FM—Upper Cretaceous and Paleocene Ser—Southeast Co, northeast NM

Hills, 1888 (CO Sci Soc Proc v 3, pt 1, p 148-164). Red and yellow clays and marls, red, white and brown ss about 8,000 ft thick. Named for exposures in Poison Canyon, CO.

Johnson and Wood, 1956 (AAPG v 40, p 714-717). Lower pt buff to red ark ss, cgl, and thin yellow sh beds; upper pt igneous and metamorphic pebble to cobble cgl. Overlies and intertongues with Raton Fm; underlies Cuchara Fm.

Johnson, Dixon, and Wanek, 1966 (NMGS 17th FC, p 94-96). Fm recognized near Cimarron and Ute Park, NM. Of Late Cret. and Paleoc. age.

Pillmore, 1969 (The Mtn Geol v 6, p 129-130). 1,000-1,500 ft of thick, massive, lenticular, ledge-forming, coarse-grained to cgltic ark ss intercalated with yellow-weathering sdy micaceous mdst. In W and SW pt of Raton field, Poison Canyon intertongues with and thickens at expense of Raton Fm; contact gradational and indefinite through 150 ft. Near Baldy Pk lower Raton Fm = lower Poison Canyon.

PURGATOIRE FM—Dakota Gp—Lower Cretaceous Ser—Southeast CO, northeast NM, OK

Stose, 1912 (USGS Apishapa Folio, no 186). Ss in lower two-thirds; sh with thin ss in upper one-third. Conf overlies Morrison Fm; conf underlies Dakota Ss. Formerly [lower] pt of Dakota. Named for Purgatoire Canyon, CO where it is 220 ft thick.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Buff, brown, and rusty ss, gray sh and sltst, and thin impure coal beds. Avgs about 65 ft thick; thins N [eastern Colfax Co] .

Baldwin and Muehlberger, 1959 (NMBB 63, p 53-54). Divided into lower massive ss mbr and upper slope-forming gray silty mdst mbr. In Union Co assigned to Dakota Gp.

Griggs and Read, 1959 (AAPG v 43, p 2007). Purgatoire name abandoned in Tucumcari-Sabinoso area. Replaced by Tucumcari Sh [no evidence of this unit in field trip area] , Mesa Rica Ss, and Pajarito Sh.

Pillmore, 1976 (this Guidebook). Equiv of Glencairn Sh Mbr recognized in Colfax Co.

RAIL CANYON SS MBR—Vermejo Fm—Upper Cretaceous Ser—NM

Lee, 1924 (USGSB 752, p 120-122). Massive cross-bedded ss near middle of Vermejo Fm forming roof in Dawson mines. Numerous inclusions of clay balls. Up to 50 ft thick. Unconf overlies coal-bearing sh and ss of Vermejo Fm. Named for Rail Canyon, Colfax Co.

RATON BASALT (BASALTS)—Miocene and Pliocene Ser—Northeast NM

Collins, 1949 (GSA v 60, no 6). High-level olivine basalt. Named for Raton Mesa, Colfax Co.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Includes an older, higher basalt 1,000-1,600 ft above adjacent stream beds and a younger, lower basalt 600-1,000 ft above stream beds. 100-500 ft thick.

Baldwin and Muehlberger, 1959 (NMBB 63, p 114-5). Conf overlies Ogallala Fm.

Stormer, 1972 (GSA v 83, no 8, p 2443-2448). K/Ar dates of 7.2±0.3 m y and 3.5±o.2 m y.

RATON FM—Upper Cretaceous and Paleocene Ser—Northeast NM, southeast CO

Hayden, 1869 (USGS Prelim Field Rept of CO and NM, p 90). Coal beds of the Raton Hills called Raton Hills Gp.

Lee, 1913 (AJS 4th, v 35, p 531). Coal-bearing rocks above the unconf in the Raton Mesa region of southern CO and NM called Raton Fm.

Lee, 1917 USGSP 101, p 56-61). Coal, carbonac sh to sdy sh, brown to buff ss and cgl (usually at base). Unconf overlies Vermejo Fm; unconf(?) underlies Poison Canyon Fm. About 1,140 ft thick.

Brown, 1954 (GSA v 54, p 65-86). Of Late Cret. and Paleoc. age.

Pillmore, 1969 (The Mtn Geol v 6, p 129). 2,000 ft thick. Three divisions: 1) basal ss—cgl of quartzite, chert, and gneiss pebbles and cobbles in a coarse-grained quartzose to ark ss matrix (mapped in W as Poison Canyon by some workers); 2) lower zone—fine to coarse-grained ss, some sltst, mdst, coal; and 3) coal-bearing zone—ss, sltst, mdst, sh, minable coal. In W pt of field, lower and coal-bearing zones intertongue with Poison Canyon Fm.

RED MOUNTAIN DACITES—Miocene Ser—Northeast NM

Collins, 1949 (GSA v 60, p 1022-1031). Hornblende dacites. Named for Red Mountain, Colfax Co.

Muehlberger, 1959 (IGC, 20th Mexico, Sec XI-A, p 228). May be pt of a long sequence of eruptions which also include Slagle Trachytes, Chico Phonolites, and Clayton Basalts.

Stormer, 1972 (GSA v 83, p 2443-2448). K/Ar age of 8.2±0.8 m y.

REDONDA FM—Upper Triassic Ser—NM

Dobrovolny and Summerson, 1946 (USGSPM 62). Buff to pink sltst and ss, variegated sh, and argil) Is 25-425 ft thick; the upper mbr; underlies Wingate(?) Ss. Named for Redonda Mesa, about 15 mi S of Tucumcari, Quay Co.

Griggs and Read, 1959 (AAPG v 43, p 2004-2006). Raised to fm rank. Overlies Chinle Fm of Dockum Gp; underlies Entrada Ss of San Rafael Gp.

Wanek, 1962 (USGSOM 208). Calcareous reddish-brown clayey sltst alternating with orange-red fine-grained ss.

RINCONADA SCHIST MBR—Ortega Fm—Precambrian Sys—NM

Just, 1937 (NMBB 13, p 22). Gray to buff quartz-muscovite schist with interbedded quartzite. Named for town of Rinconada 2 mi N of Dixon in Rio Grande Canyon, Rio Arriba Co.

Montgomery, 1953 (NMBB 30, p 12-19). Four units: andalusite-biotite hornfels; staurolite-rich schist and gneiss; quartzite; and muscovite-quartz-biotite-garnet phyllite. About 1,800 ft thick.

SAN ANDRES LS—Lower Permian (Leonardian to lower Guadalupian) Ser—NM, TX

Lee, 1909 (USGSB 389). Massive often cherty and poorly fossilif ls. 500 ft thick. Named for San Andres Mtns, southern NM.

Needham and Bates, 1943 (GSA v 54, p 1664-1666). In central and SE NM chiefly calc ls with some dol beds. In N pt of NM it is thin and crops out discontinuously, Sss near base are like Glorieta Ss, but Glorieta considered separate fm.

Read and Andrews, 1944 (USGSPM 8). Glorieta Ss Mbr of San Andres Fm 100-250 ft thick; ls mbr 1-20 ft thick; upper mbr 0-80 ft thick.

Bachman, 1953 (USGSOM 137). Three mbrs of San Andres Fm in central NM: lower ss mbr (Glorieta), ls mbr, and upper clastic mbr. Only Glorieta exposed in map area, 266 ft thick. Upper mbr removed and named Bernal Fm.

Dane and Bachman, 1962 (USGSI 358). Glorieta Ss (formerly basal ss mbr), San Andres Ls (restricted to ls mbr), and Bernal Fm (formerly upper clastic mbr).

SANDIA FM—middle Pennsylvanian (Atokan)—NM

Herrick, 1900 (JG v 8, p 112-126; Amer Geol v 25, p 234-237; NM Univ. Bull v 2, pt 3, p 1-14). Sh, ss, cgl 150 ft thick. Named for Sandia Mtns.

Baltz and Bachman, 1956 (NMGS 7th FC, p 96-99). Sandia Fm of Magdalena Gp divided into a lower ls mbr of Devon.(?) and Miss. age, and an upper pt (cgltic ss, sltst, carbonaceous sh with some ls and coal) of Early Penn. age. Overlies Precamb. rocks; underlies Madera Fm.

Baltz and Read, 1960 (AAPG v 44, p 1749). Lower ls mbr called Espiritu Santo and Tererro Fms restricting Sandia to ss and coaly sh of Penn. age.

SANGRE DE CRISTO FM—middle to upper Pennsylvanian, Lower Permian Ser—CO, NM

Hills, 1899 (USGS Elmoro folio, No 58, p 1). Thick Carb. sediments. Named for Sangre de Cristo Mtns, CO.

Hills, 1900 (USGS Walsenburg folio, No 68). Red ss and coarse gravel several thousand ft thick. Underlies Morrison Fm.

Bachman, 1953 (USGSOM 137). Brownish-red cgl, ark, ss, sh 943 ft thick. Overlies Magdalena Gp; underlies and intertongues with Yeso Fm.

Baltz and Bachman, 1956 (NMGS 7th FC, p 100-101). Thick beds coarse-grained cgl; ark ss; red, green, gray sh and sltst; few beds gray or pink ls. Some ls fossilif. Carbonac sh and coal beds locally. Lower contact at highest marine ls of Magdalena Gp.
Sutherland, 1963 (NMBM 11, p 38-39). Restricted to ark and redbeds 700 ft thick overlying Alamitos Fm.

Clark and Read, 1972 (NMBB 94, p 42-45). As much as 5,300 ft thick. Overlies Precamb; underlies Yeso or Glorieta Fms or Dockum Gp.

SAN RAFAEL GP—Upper and Middle Jurassic Ser—UT, AZ, NM, CO

Gilluly and Reeside, 1928 (USGSP 150, p 73-80). Includes Carmel, Entrada, Curtis, and Summerville Fms. Unconf overlies Navajo Ss; unconf underlies Morrison Fm. Named for exposures in San Rafael Swell, UT.

Griggs and Read, 1959 (AAPG v 43, p 2005-2006). Includes Entrada Ss and Bell Ranch Fm [Wanakah equiv of some authors] .

SANTA FE GP—middle(?) Miocene to Pleistocene(?) Ser—NM, CO

Hayden, 1969 (USGS Prelim Field Rept of CO and NM, p 66, 90). Cream to yellow-white marls and very fine to coarse sands that occupy greater portion of Rio Grande valley between Santa Fe and Gallisteo Creek called Santa Fe marls. 1,200-1,500 ft thick.

Baldwin, 1963 (USGSW 1525, p 38-63). Raised to gp rank; includes sedimentary and volcanic rocks related to Rio Grande trough assigned to: Tesuque and Ancha Fms and intertongued basalt tuffs and flows.

Dane and Bachman, 1965 (Geologic Map of NM). Two isolated occurrences of Santa Fe Gp, undivided, in Latir Mtns.

SANTA ROSA SS—Dockum Gp—Upper Triassic Ser—NM, TX

Hager and Robitaille, 1919 (Geol Rept on oil possibilities in eastern NM, correlation table). In Las Vegas area and to east is 500-600 ft thick. Overlies San Andres Ls; underlies Trias. red and white beds.

Rich, 1921 (AJS 5th v 2, p 295-298). Coarse gray ss, cgltic at base, 50-100 ft thick. Named for town of Santa Rosa, Guadalupe Co.

Darton, 1922 (USGSB 726-E, p 183). Placed in Dockum Gp.

Bachman, 1953 (USGSOM 137). Brownish-red sh and ss. Five cgltic ss ledges. 425 ft thick. Overlies Bernal Fm; underlies Chinle Fm.

Baldwin and Muehlberger, 1959 (NMBB 63, p 31). Tentatively correlated with Baldy Hill Fm.

SHEEP PEN SS—Dockum Gp—Upper Triassic Ser—Northeast NM

Parker, 1933 (JG v 41, p 41). Buff to tan ss 68 ft thick. Overlies Sloan Canyon Fm; underlies Entrada Ss. Type loc, sec 35, T 32 N, R 35 E., at Sheep Pen Canyon, Union Co.

Baldwin and Muehlberger, 1959 (NMBB 63, p 40-42). Assigned to Dockum Gp. Overlain by Exeter Ss (Ocate equiv).

SLAGLE TRACHYTES—Quaternary Sys—Northeast NM

Collins, 1949 (GSA v 60, p 1022). Trachytes named for Slagle Canyon, W of Chico, T 26 N, R 25 E, Colfax Co.

Muehlberger, 1959 (IGC, 20th Mexico, Sec XI-A, p 228). May be pt of long sequence of eruptions which also include Red Mountain Dacites, Chico Phonolites and Clayton Basalts.

SLOAN CANYON FM—Dockum Gp—Upper Triassic Ser—Northeast NM

Parker, 1933 (JG v 41, p 41-42). Pale, variegated, argil) and calc shs with thin layers of marl and ss 125-150 ft thick. Overlies Dockum Gp; underlies Sheep Pen Ss. Named for exposures along Sloan Canyon near the slab crossing (now NM Hwy 325). Baldwin and Muehlberger, 1959 (NMBB 63, p 39-40). Overlies Travesser Fm. Assigned to Dockum Gp.

SMOKY HILL MARL MBR--Niobrara Fm—Upper Cretaceous Ser—KS, CO, NE, SD, NM

Cragin, 1896 (CO College Stud, v 6, p 51). Chalky and marly lss and chalk. Named for Smoky Hill R, KS.

Wood, Northrop, and Griggs, 1953 (USGSOM 141, Sheet 2). Lower 150-200 ft is gray to dark-gray, calc, slightly silty sh with several thin lss. Upper 550-650 ft gray, calc, aren sh. Overlies Fort Hays Mbr; underlies Pierre Sh.

TERERRO FM—Arroyo Peñasco Gp—Upper Mississippian Ser—North-central NM

Baltz and Read, 1960 (AAPG v 44, p 1759-1768). Ls breccia, calcarenite, thin-bedded crystalline ls and sltst. Formerly upper pt of lower ls mbr of Sandia Fm. Divided into 3 mbrs: Macho, Manuelitas and Cowles. Unconf overlies Espiritu Santo Fm; unconf underlies Sandia Fm. Type loc on slope above and N of quarry near confluence of Holy Ghost Creek and Pecos R at Tererro, San Miguel Co where it is about 118 ft thick.

Armstrong and Mamet, 1974 (NMGS 25th FC, p 146-150). Divided into Macho, Turquillo, Manuelitas, and Cowles Mbrs. Meramecian and Chesterian (Late Mississippian) in age. Included in Arroyo Peñasco Gp.

TRAVESSER FM—Dockum Gp—Upper Triassic Ser—Northeast NM

Baldwin and Muehlberger, 1959 (NMBB 63, p 38). Clayey silt and very fine-grained ss. Ss thick- to thin-bedded. Cgltic lenses of pebbles of calc mdst and very fine-grained ss common. Mostly medium red-brown but may be orange to dark red-brown. Overlies Baldy Hill Fm; underlies Sloan Canyon Fm. Named for Travesser Creek, Union Co; type sec in sec 12, T 31 N, R 22 E where it is 245 ft thick.

TRINIDAD SS—Upper Cretaceous Ser—Southeast CO, northeast NM

Hills, 1899 (USGS Elmoro Folio). Thin layers fine-grained, dary gray ss with sh partings (lower); light gray ss (upper). Overlies Pierre Fm; underlies Laramie Fm. About 150 ft thick. Named for exposures near Trinidad, CO.

Richardson, 1910 (USGSB 381, p 385-386). Recognized as fm in Montana Gp in NE NM.

Lee and Knowlton, 1917 (USGSP 101, p 48). Restricted Trinidad to "Upper Trinidad" of Hills (1899), the massive feldspathic ss. "Lower Trinidad" of Hills mapped with Pierre Sh.

Griggs, 1948 (NMBG 1, p 33-34). Massive to thin-bedded light gray to light buff feldspathic ss. Conf overlies and interfingers with Pierre Sh; conf underlies and interfingers with Vermejo Fm. 100 ft thick.

Gill and Cobban, 1973 (USGSP 776, p 12). Removed from Montana Gp because gp restricted to central MT.

TURQUILLO MBR—Tererro Fm, Arroyo Peñasco Gp—Upper Mississippian Ser—North-central NM

Armstrong and Mamet, 1974 (NMGS 25th FC, p 150). Thick-bedded mdst-wackestone of Meramecian age. Unconf on Macho; underlies Manuelitas Mbr. At type sec, E side of Rincon Range, Mora Co, 4 mi S of village of Turquillo, is 2 m thick.

VADITO FM—Precambrian Sys—North-central NM

Montgomery, 1933 (NMBB 30, p 21-35). Metasedimentary rocks interbedded with flows and sills of metaigneous rocks. Divided into lower cgl mbr and upper schist mbr. About 4,500 ft thick. Unconf overlies Ortega Fm. Named for exposures near village of Vadito, Taos Co.

VERMEJO FM—Upper Cretaceous Ser—Northeast NM, southeast CO

Lee, 1913 (AJS 4th, v 35, p 531). Coal-bearing rocks below unconf in Raton Mesa region of CO and NM.

Lee, 1917 (USGSP 101, p 51-55). Light-gray, soft, friable ss and sh which can be carbonac and have coal seams or thin coal beds. 375 ft thick. Unconf overlies Trinidad Ss; unconf underlies Raton Fm. Type loc Vermejo Park, Colfax Co.

WANAKAH FM—San Rafael Gp—Upper Jurassic Ser—NM, CO

Burbank, 1930 (C) Sci Soc Proc v 12, no 6, p 172). Breccia, ls, sh at base; ss in middle; sh at top. 125 ft thick. Basal mbr of Morrison. Overlies Jurassic ss; underlies ss mbr of Morrison. Named for exposures in Wanakah mine, CO.

Bachman, 1953 (USGSOM 137). Gray to brown sh, ss, and ls. Overlies Ocate Ss; underlies Morrison Fm. Of fm rank. About 25 ft thick.

Griggs and Read, 1959 (AAPG v 43, p 2006). Name Wanakah restricted to type area in SW CO; name Bell Ranch Fm defined for rocks between Entrada Ss and Morrison Fm in NM.

Clark, 1966 (NMGS 17th FC, p 60). Sh, ls, gyp, and ss 30-100 ft thick. Wanakah equiv present between Entrada Ss and Morrison Fm.

Pillmore, 1976 (this Guidebook). Ralston Creek(?) Fm used for rocks between Entrada and Morrison fms.

WHITEHORSE FM—Upper Permian Ser—OK, KS, NM

Gould, 1905 (USGSW 148, p 52, 55-57). Light-red sss and shs called Whitehorse Ss Mbr of Woodward Fm. Overlies Dog Creek Mbr; underlies Day Creek Mbr. 175 or 200 ft thick. Named for Whitehorse Springs, Wood Co, OK.

Baldwin and Muehlberger, 1959 (NMBB 63, p 30-31). Whitehorse Fm—reddish-brown and reddish-orange gypsif mdst and clyst containing small crystals of dol (lower); light gray to white very finely crystalline dol (Alibates Dol; middle); very fine-grained reddish-orange ss (upper). About 400 ft thick in E Union Co; thins W.

Tait and others, 1962 (AAPG v 46, p 505). Replaced in NM by term Artesia Gp.

YESO FM—Lower Permian Ser (Leonardian)—NM, TX

Lee, 1909 (USGSB 389). 1,000-2,000 ft of pink, yellow, red, purple coarse-grained, friable ss; pink to yellow, locally gypsif sh; gyp; and ls. Overlies Abo Ss; underlies San Andres Ls. Type loc Mesa del Yeso, a small tableland 12 mi NE of Socorro.

Bachman, 1953 (USGSOM 137). Pinkish sltst. Overlies and interfingers with Sangre de Cristo Fm to N; underlies Glorieta Ss to S. Water gap at Coyote Creek near Lucero, Mora Co, is N limit.

Baldwin and Muehlberger, 1959 (NMBB 63, p 29-31). Excludes Tubb (as economic term) and Cimarron Anhydrite, and includes some beds similar to Glorieta Ss. Maximum 500 ft thick in SE Union Co.