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STRATIGRAPHIC NOMENCLATURE AND CORRELATION CHART FOR EAST-CENTRAL NEW MEXICO

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INTRODUCTION

The stratigraphic nomenclature and ages of Phanerozoic units in east-central New Mexico are summarized in the accompanying chart (Fig. 1). The chronostratigraphic scale on the left side of the chart is from Harland et al. (1982). It is not a complete scale; the missing chronostratigraphic units reflect gaps in the lithostratigraphic record of east-central New Mexico. The following abbreviations are used: E = Early, L = Late, M = Middle, Ma = Meganna (million years), Ng = Neogene, PEN = Pennsylvanian, PER = Period, Pg = Paleogene, Q = Quaternary, SUB-P = Sub-Period, and TERT = Tertiary. The lithostratigraphic units generally run from the north/northwest (southern Sangre de Cristo Mountains–Las Vegas) to the south/southeast (Pedernal Mountains–Fort Sumner), with exceptions noted below.

EXPLANATORY NOTES

Cenozoic units

Only upper Cenozoic (late Miocene and younger) rocks are preserved in east-central New Mexico, and their complex stratigraphic and temporal relationships are greatly understated by Figure 1. Pliocene and Quaternary units in Figure 1 are a simplification of Hawley et al. (1976, table 3, columns O–Q). Holocene (and, in some places, late Pleistocene?) dune sands, alluvium, colluvium, soils and caliche are present throughout east-central New Mexico. Early Pleistocene basalts from the Maxon Crater (12 km west of Wagon Mound) are present beyond the confluence of the Mora and Canadian Rivers in the northwestern part of east-central New Mexico. These deposits are generally underlain by the terrace deposits of the ancestral, through-flowing upper Pecos and Brazos River systems, as well as by interbedded sands and caliches (multiple paleosols). These are Plio-Pleistocene strata that need more precise age determinations.

The eolian Blackwater Draw Formation (Reeves, 1976) of the Llano Estacado is of middle Pleistocene age. It formerly was termed "cover sands" by Frye and Leonard (1957). The Gatuña Formation (Land, 1938) represents the oldest Pleistocene (and late Pliocene?) channel-fill deposits of the lower Pecos Valley in southeastern New Mexico. Kelley (1980, p. 215) identified about 100 km² of "reddish sand and gravel, mostly lying beneath extensive pediments" in the Fort Sumner area as Gatuña. The Ogallala Formation is the oldest Cenozoic unit in east-central New Mexico. It ranges in age from possibly late Miocene (ca 10 m.y.B.P.) to early Pliocene (ca 4 m.y.B.P.) (Hawley, 1984).

Cretaceous units

The Upper Cretaceous Dakota–Graneros–Greenhorn–Carlile sequence in the Las Vegas area and eastward has been dated securely by marine invertebrate fossils (chiefly inoceramid bivalves and ammonoids: Kauffman et al., 1969; Hook and Cobban, 1980, fig. 4; Cobban, 1984). Members of the Greenhorn and Carlile have been recognized in northeastern New Mexico, but are not included on Figure 1 because of space limitations. Direct biostratigraphic evidence of the age of the basal Dakota in this area is not available.

The Tucumcari Shale has a diverse marine invertebrate mega- and microfauna of Albian age (Scott, 1970, 1974; Brand and Mattox, 1972; Kues et al., 1985). *Lopha quadriplicata*, the only fossil reported from the Pajarito Shale, is consistent with either an Albian or Cenomanian age (Dobrovolsky et al., 1946; Scott, 1970). The intervening Mesa Rica Sandstone has been interpreted as a deltaic facies of part of the Dakota

(Scott, 1970; Gage and Asquith, 1977; Mateer, 1985) or as a unit separated from the Dakota by the Pajarito Shale (Wanek, 1962). We tentatively support Wanek's interpretation, but more study is needed to ascertain the relationship between these two formations.

Jurassic units

Jurassic stratigraphic nomenclature and age assignments in Figure 1 follow Lucas et al. (1985b). Assignment of the traditional Late Jurassic (Kimmeridgian–Tithonian) age to the Morrison Formation of east-central New Mexico is based on the presence of typical Late Jurassic vertebrates (*Stegosaurus*, *Allosaurus*, sauropods) in the Morrison of east-central New Mexico. This indicates a significant unconformity (Berriasian through Aptian, about 30 m.y.) between the Morrison and overlying Tucumcari Shale.

Fossil fishes from the Todilto Formation of east-central New Mexico suggest an early Callovian age (Schaeffer and Patterson, 1984). The Bell Ranch Formation of Griggs and Read (1959), a unit homotaxial with the Wanakah of southwestern Colorado and Summerville of southeastern Utah, apparently is conformable with the Todilto, Exeter and Morrison in east-central New Mexico. This homotaxis and conformity suggest that middle–upper Callovian and all of Oxfordian time may be represented by the Bell Ranch. However, biostratigraphic evidence is lacking, and the possibility that significant intraformational unconformities are present must be entertained.

Lee's (1902) name Exeter is here recognized as an upper eolian and water-laid sandstone tongue (tongues?) of the Entrada Sandstone that overlies the Todilto, underlies or is laterally equivalent to the Bell Ranch, and/or directly overlies the main Entrada sandstone body. The unit identified as Entrada (assigned the Bathonian age attributed to the Entrada elsewhere) previously was misidentified as Wingate (Darton, 1928; Dobrovolsky et al., 1946), as Heaton (1939) demonstrated (also see Griggs and Read, 1959, and Wanek, 1962, among others). Some workers (e.g., Mankin, 1972) applied the name Exeter to what is here termed Entrada. The Ocate Sandstone of Mora County (Bachman, 1953) is the same as the Entrada. Despite the apparent lack of significant stratigraphic relief, the Entrada–Chinle (Redonda Member) contact in east-central New Mexico evidently represents a significant unconformity of about 40-m.y. duration (Rhaetian–Bajocian time), the "J-2 unconformity" of Pippingos and O'Sullivan (1978).

Triassic units

Triassic strata in east-central New Mexico are assigned to the Chinle and Santa Rosa Formations. Recognition of the Redonda (= Naranjo Formation of Bachman, 1953) as a member of the Chinle Formation follows the original scheme of Dobrovolsky et al. (1946). This, and the correlation presented here of the Chinle of east-central New Mexico with the Dockum Group of western Texas, follows Lucas et al. (1985c). This stands apart from previous correlations of the Santa Rosa Formation with the Trujillo Formation of the Dockum Group, a correlation refuted by the physical stratigraphy of Finch et al. (1976) and the vertebrate biostratigraphy of Lucas and Morales (1985). The "upper shale unit" of the Dockum (Drake, 1892) in western Texas produces a vertebrate fauna approximately coeval with vertebrates from the upper shale member of the Chinle in east-central New Mexico (Chatterjee, in press), whereas vertebrates from the Redonda Member in east-central New Mexico arguably are younger than any Dockum fauna (Lucas et

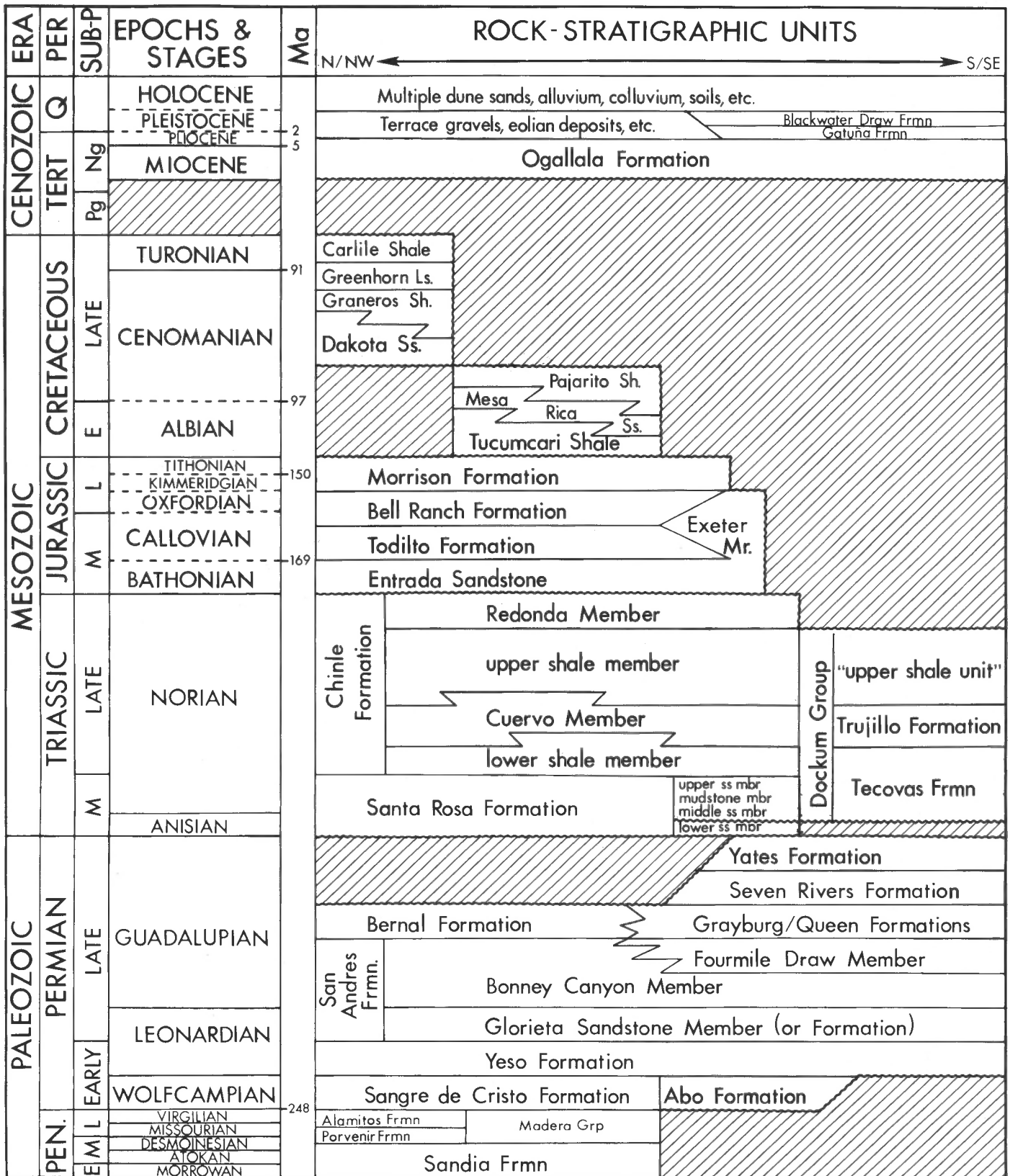


FIGURE 1. Stratigraphic nomenclature and correlation chart for Phanerozoic rocks in east-central New Mexico.

al., 1985a, c). The "Logan Sandstone" of Trauger et al. (1972) clearly is the same as Kelley's (1972a, c) Cuervo [Sandstone] Member (Finch et al., 1976).

The Santa Rosa Formation has been informally divided into two (Kelley, 1972a, b), three (Read et al. in Kelley, 1972a; Broadhead, 1984), and four (Gorman and Robeck, 1946; Lupe, 1977; McGowen et al., 1979; Finch and Wright, 1983) units, based mainly on local mapping. In north-central Guadalupe County, Gorman and Robeck (1946) recognized a lower friable, purplish-red sandstone, a middle gray to brown sandstone, a red to gray shale, and an upper brown to gray sandstone. Kelley (1972a, c) observed only two units in the Santa Rosa area, a lower purplish-brown unit equivalent to the lower sandstone of Gorman and Robeck, and a massive buff upper unit with little shale equivalent to Gorman and Robeck's upper three members. Broadhead (1984, p. 12), working from subsurface cores through Guadalupe and adjacent counties, recognized three divisions, noting that they are "widespread and recognizable stratigraphic units in northeast New Mexico." Broadhead's lower sandstone unit is equivalent to Gorman and Robeck's lower and middle sandstone members, and his middle mudstone and upper sandstone units equal the shale member and upper sandstone members, respectively, of Gorman and Robeck.

An Anisian amphibian from the basal Santa Rosa near Dilia (Lucas and Morales, 1985) is the only vertebrate biostratigraphic evidence of the age of this unit. Fossil plants from the upper part of the Santa Rosa (Ash, 1972) indicate a Norian age, but further data are needed to evaluate the upper age limit of the Santa Rosa.

Permian units

The Permian stratigraphy portrayed in Figure 1 generally follows that of Kelley (1972a, b). Exposed Wolfcampian strata are limited to the Sangre de Cristo Formation south and west of Las Vegas; its southern and western equivalent, the Abo Formation, is present only in the subsurface through the guidebook area. Kelley traced the Fourmile Draw Member of the San Andres as far north as the Vaughn area; the underlying Bonney Canyon Member represents the entire San Andres above the Glorieta through the remainder of east-central New Mexico. Placement of the Leonardian-Guadalupian boundary in the San Andres sequence here is uncertain, as paleontological data are lacking. The marine invertebrate fauna of the type San Andres (San Andres Mountains) is abundant but largely unstudied; it is of Leonardian aspect, but could be lower Guadalupian (Kottlowski, 1969). Farther south, in the Guadalupe Mountains, most of the San Andres is Guadalupian, based on fusulinids. Following most previous workers, we have considered the Glorieta to be upper Leonardian; the overlying Bonney Canyon Member may also be Leonardian, although we have placed it at the base of the Guadalupian in Figure 1.

The Grayburg-Queen, Seven Rivers, and Yates Formations comprise the Artesia Group in the guidebook area. The latter two units wedge out some 20 miles south of Santa Rosa, whereas the Grayburg-Queen is well exposed along the Pecos River and continues north to the southern end of the Sangre de Cristos as the Bernal Formation. Kelley (1972a, p. 15) recommended that the term Bernal be used for this unit north of Santa Rosa and west of Vaughn.

Pennsylvanian units

Rocks of Pennsylvanian age are exposed along the southeastern side of the Sangre de Cristo Mountains, just west of Las Vegas. In this area Baltz and Myers (1984) recently recognized a tripartite division of the Pennsylvanian, consisting of the basal Sandia Formation (Morrowan-Desmoinesian) overlain by the Porvenir (Desmoinesian) and Alamitos (Desmoinesian-Virgilian) Formations of the Madera Group. The ages of these units are well established on the basis of brachiopods and fusulinids. The stratigraphic concepts of Baltz and Myers (1984) vary considerably from those of Sutherland (1963), who rejected usage of the terms Sandia and Madera in the Sangre de Cristo Mountains. Northwest of Las Vegas the Sandia Formation rests on thin Mississippian remnants, the Arroyo Peñasco Group, not shown in Figure 1.

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