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NAUTILOIDS FROM THE EARLY PERMIAN YESO GROUP, OTERO COUNTY, NEW MEXICO

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ABSTRACT—We document specimens of the nautiloid *Temnocheilus* sp. from the upper part of the Early Permian Yeso Group at Otero Mesa in Otero County, southern New Mexico. *Temnocheilus* has a long stratigraphic range (Pennsylvanian-Middle Permian) and was previously well known from Leonardian strata in West Texas. Its occurrence at Otero Mesa indicates that more fossils of open marine animals are to be found in Yeso strata and thereby provide a better biostratigraphy of the Yeso Group.

INTRODUCTION

The Early Permian Yeso Group (Formation) is one of the most extensively exposed stratigraphic units of Permian age in New Mexico. From northern New Mexico (Sandoval County) through the uplifts that adjoin the Rio Grande Valley southward to Las Cruces, and across the mountain ranges of southeastern New Mexico, Yeso strata are as much as 350 m thick and are primarily recognized by their gypsum beds (e. g., Needham and Bates, 1943; Kottlowski et al., 1956; Dinterman, 2001; Mack and Dinterman, 2002; Kues and Giles, 2004; Lucas et al., 2005, 2013; Lucas and Krainer, 2012). Yeso Group deposition took place along the vast northwestern shelf of the Permian basin during part of Early Permian (Leonardian) time. To the northwest, the De Chelly erg, which covered much of the Four Corners and southern Colorado Plateau, represents the northwestern limit of the Yeso lithosome. To the southeast, in the Permian basin, Yeso strata grade into/interfinger with marine strata of the Bone Spring Formation. The extensive area in between these extremes was of low relief and variably covered by coastal dunes and sandflats, wadis, sabkhas and shallow marine shelves.

Because of the nature of many Yeso facies—eolian, sabkha, evaporitic—they have long been seen as relatively unfossiliferous. However, recent work has revealed a greater abundance of Yeso fossils than previously known, especially of terrestrial trace fossils and marine microfossils (Lucas et al., 2013; Vachard et al., 2013). Here, we add to the fossil record of the Yeso Group some nautiloids from Otero Mesa in southern Otero County (Fig. 1). These nautiloids are an important indicator that more marine macrofauna remains to be discovered in Yeso strata.

STRATIGRAPHIC CONTEXT

The Yeso Formation of traditional usage consists of various members, some of which are relatively thick (up to 250 m) and lithologically distinctive units that have been routinely mapped by various workers at reasonable scales (including 1:24,000). Because of this, we concluded that the Yeso members merit formation rank, so we raised the Yeso to group rank (Lucas et al., 2005, 2013). The thickness, lithologic distinctiveness and great areal extent of the Yeso subdivisions (traditional members), and the fact that some of them can be further subdivided, warranted raising Yeso to group rank (but see Cather et al., 2013 for a different view on Yeso stratigraphy). Broadly correlative or homotaxial units of similar thickness and extent are also group-rank units, such as the Clear Fork Group of Texas, the Supai Group of Arizona and the Cutler Group of the Four Corners.

In northern and central New Mexico, the Yeso Group consists of a basal, clastic-dominated interval (DeChelly and Arroyo de Alamillo formations) overlain by a complex succession of gypsum, siltstone, dolomite and sandstone, the Los Vallos Formation. We have been studying Yeso stratigraphy in the Sacramento Mountains and Otero Mesa region of Otero County since 2012. Here, the Yeso lithofacies differ from those exposed towards the northwest and west (Bachman and Hayes, 1958; Pray, 1961), and will merit some new lithostratigraphic nomenclature.

Pending completion of our studies, we use a mostly informal lithostratigraphic nomenclature to describe the Yeso Group section (~266 m thick) at Otero Mesa (Fig. 2).

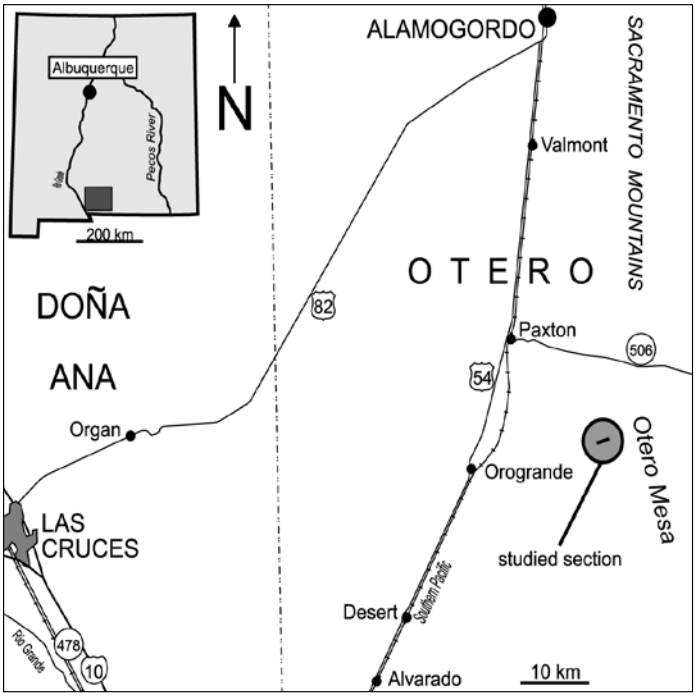

FIGURE 1. Map of New Mexico showing location of Otero Mesa section of the Yeso Group (see Fig. 2).

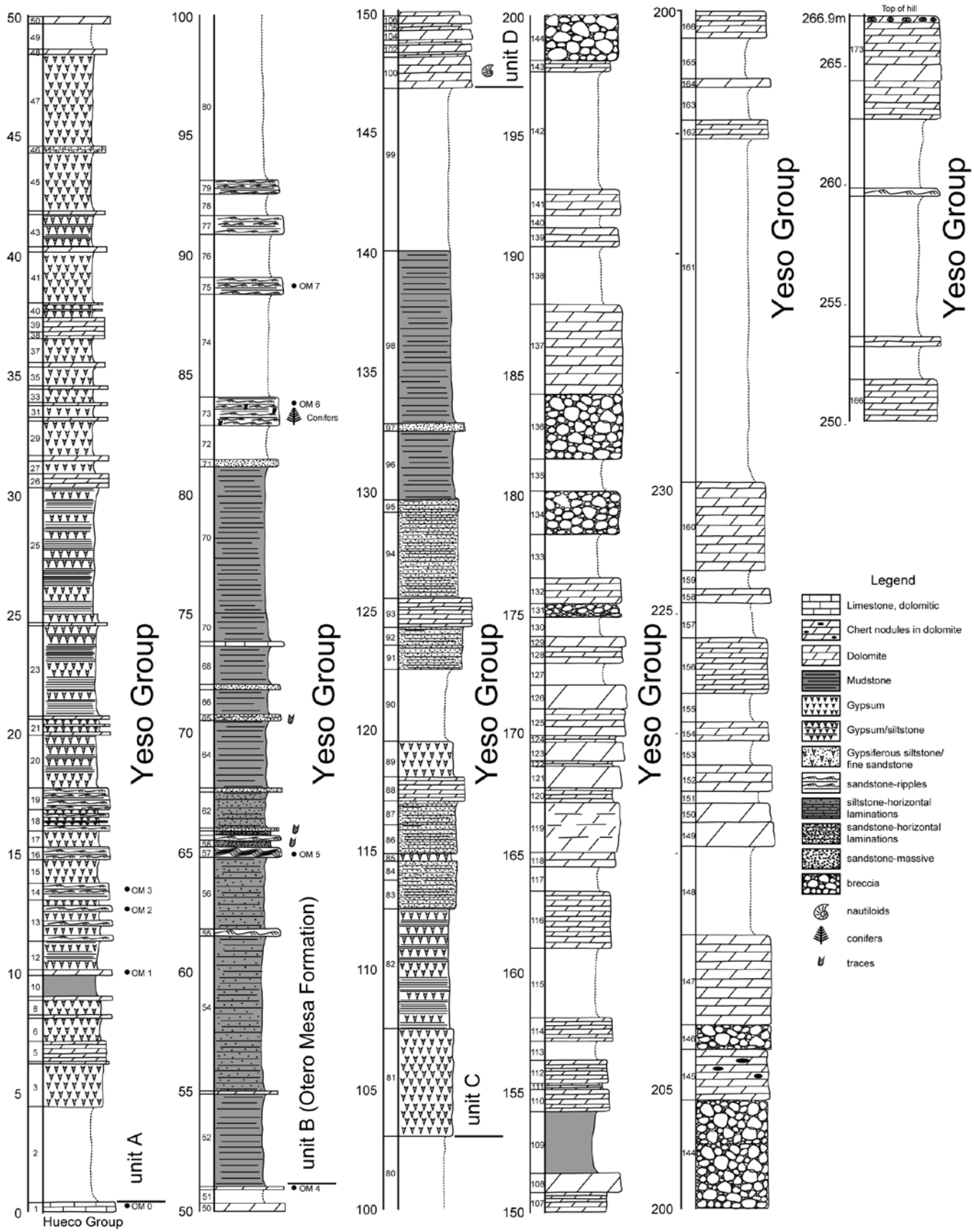

FIGURE 2. Measured stratigraphic section of the Yeso Group section at Otero Mesa. Base of section is at UTM zone 13, 415425E, 3584464N and top is at 416685E, 3584080N (NAD 83). Thus, the section was measured in sections 14 and 15, T22S, R10E. OM 1, 2 3, etc., indicate sampling levels for petrographic samples.

Thus, we divide Yeso strata there into four lithostratigraphic units:

1) Unit A is the lowermost interval of the Yeso Group, 50.6 m thick, and consists of interbedded gypsum and dolostone. The base of this unit is a 4 m thick bed of reddish gypsiferous siltstone that rests on limestone (wackestone) of the Cerro Alto Formation of the Hueco Group. Gypsum of unit A is indistinctly laminated to laminated and commonly contains intercalated beds of mm- to cm-thick laminated, gray to dark gray dolomitic shale. Individual gypsum horizons are up to 5 m thick, mostly 0.6–2 m thick. Dolomite is gray and occurs as thin beds (0.1–0.2 m), and rarely as up to 0.6 m thick horizons intercalated in gypsum. Siltstone to fine-grained sandstone beds are greenish-gray and reddish, 0.1–0.9 m thick and horizontally laminated or ripple laminated. Siltstone to fine-grained sandstone beds are intercalated in gypsum in the lower part of the unit, but this facies is rare in the upper part.
2) Unit B is the Otero Mesa Member of the Yeso Formation of Bachman and Hayes (1958). This member is 52 m thick and is composed of mostly reddish to brownish mudstone, siltstone and fine-grained sandstone. Mudstone to siltstone is commonly laminated and partly poorly exposed. Siltstone to fine-grained sandstone beds are 0.1–1.2 m thick, mostly reddish to brownish, and rarely greenish. Sedimentary structures are horizontal lamination, ripple lamination, rare climbing ripples, and massive sandstone. Rarely, mudcracks are observed. Distinctive beds contain burrows (*Scoyenia*, *Skolithos*), walchian conifers and vertebrate footprints. One thin (0.1 m) laminated dolomite bed and one muddy nodular red calcrete bed (0.2 m) are also present.
3) Unit C is ~48 m thick and consists of gypsum (up to 4.5 m thick), gypsiferous siltstone (up to 5 m thick), red siltstone (up to 7.2 m thick), greenish shale and siltstone (partly laminated and up to 1 m thick) and two horizons of bedded dolomite (1 and 1.2 m thick), intercalated in the upper part. The dolomite is gray, thin bedded (mostly 5–10 cm) and partly laminated.
4) Unit D is at least 119 m thick (its top is not exposed in the section we studied) and is mostly bedded dolomite. The nautiloids we document here were collected stratigraphically low in unit D, about 1.2 m above its base, at New Mexico Museum of Natural History (NMMNH) locality 8825 on the flank of Otero Mesa (Fig. 2). This unit consists mostly of dolomite, which occurs as: (1) thin-bedded dolomite; (2) thin-bedded and laminated dolomite (1–2 cm); (3) thick-bedded to massive dolomite; (4) intraformational breccia horizons, 1.8–6.4 m thick, composed of dm-size, angular dolomite clasts; and (5) rare, intercalated pale green shale (2.6 m thick). Dolomite horizons are mostly < 2 m thick, but a few are thicker (up to 3.8 m). Covered intervals are present in the upper part of unit D and are up to 14.4 m thick.

DESCRIPTION AND IDENTIFICATION

We collected two internal casts (Steinkerns) of nautiloids at NMMNH locality 8825. The better-preserved specimen, NMMNH P-68652 (Fig. 3A-B), has a maximum diameter of 70 mm and an umbilicus up to 20 mm wide. The shape of the shell is thick and sub-discoidal in lateral view with whorls that gradually expand from the umbilicus, which is large and open with steep walls. The whorl cross section is subtrapezoidal, has a maximum diameter of ~30 mm, and the venter is smooth and flat to very gently convex. Some faint, fine growth lines can be seen that cross the flanks and venter. There is a single row of thick nodes on the flanks that are closer to the umbilicus at the inner whorl and approach a ventrolateral position towards the outer part of the whorl. The second, less well-preserved specimen, NMMNH

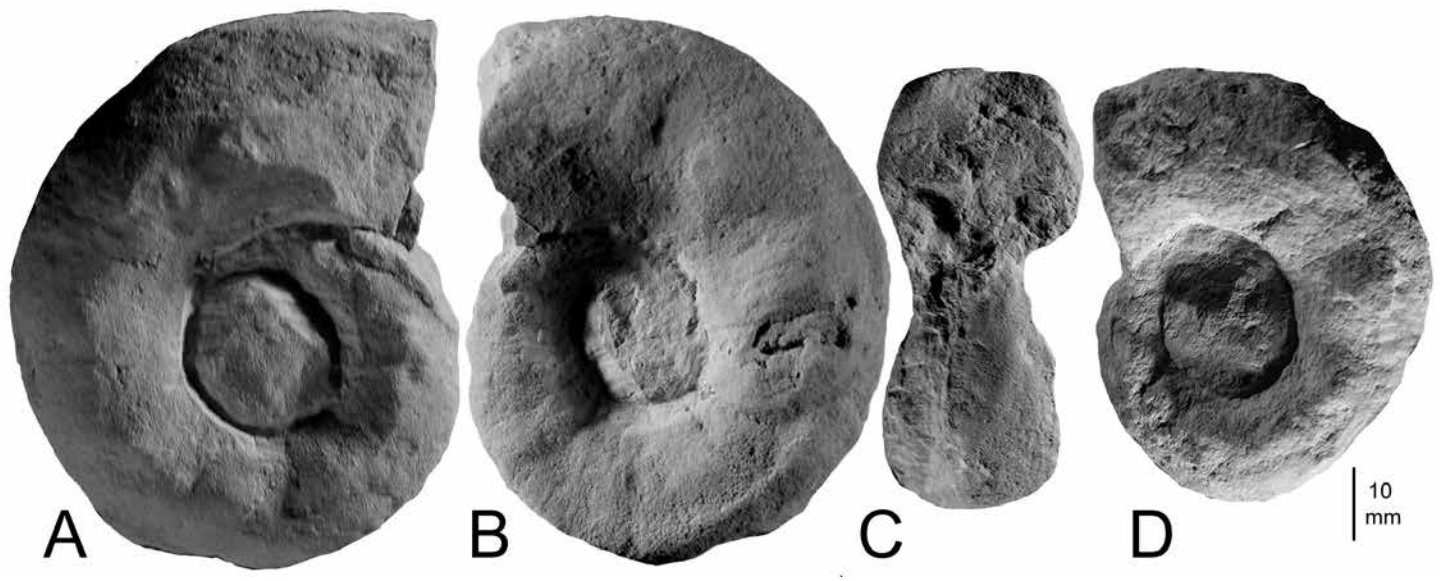

FIGURE 3. Nautiloids from the Yeso Group at Otero Mesa, Otero County, New Mexico. A-B. NMMNH P-68652, *Temnocheilus* sp., lateral views of internal cast. B. NMMNH P-68651, *Temnocheilus* sp., whorl cross section (C) and lateral (D) views. Both specimens are from NMMNH locality 8825 in bed 100 of the measured section in Figure 2.

P-68651 (Fig. 3C-D), is slightly smaller than but otherwise identical morphologically to NMMNH P-68652.

These nautiloids are poorly preserved, but their flank tubercles/nodes support assigning them to the Tainoceratidae sensu (Miller and Youngquist, 1949). Furthermore, all observable morphology supports assignment to the tainoceratid genus *Temnocheilus* (cf. Miller and Youngquist, 1949, pl. 36, figs. 1–4; Kummel, 1953, pl. 1, figs. 1–2). Particularly important is the lack of ornamentation on the venter, which excludes assignment to the closely related genera *Aulametacoceras*, *Foordiceras* and *Tainoceras* (Miller and Unklesbay, 1942; Miller, 1945; Miller and Youngquist, 1949; Kummel, 1953). The presence of a single row of flank tubercles and the subtrapezoidal whorl cross section exclude *Metacoceras*.

Kummel (1953, p. 18) recognized 23 named species of *Temnocheilus*, and the genus has a long stratigraphic range from Pennsylvanian through Middle Permian. We do not assign our specimens to a species because of poor preservation, and note that *Temnocheilus* has been previously reported from Yeso strata (Girty, 1909) and is well known from Leonardian strata in West Texas (Miller and Youngquist, 1949). Note, however, that Miller and Youngquist (1949) suggested that the Yeso records of *Temnocheilus* reported by Girty (1909) are more likely specimens of a different genus, *Stearoceras*, so the specimens documented here from Otero Mesa may be the first Yeso record of *Temnocheilus*.

DISCUSSION

In New Mexico, the Yeso Group has long been perceived of as a relatively unfossiliferous interval. Marine fossils are rare and typically poorly preserved. Those that are good age indicators, such as conodonts and fusulinids, are not present because of the very shallow and often harsh (evaporitic, hypersaline) marine facies. However, carbonate rocks (mostly dolomitized limestone) of the Yeso Group do locally contain bivalves, brachiopods, gastropods, echinoderms, smaller foraminifers, ostracods, rare bryozoans and locally abundant calcareous algae (dasycladacean) and cyanobacteria (locally forming oncoids) (Vachard et al., 2013). Girty (1909) and Miller and Youngquist (1949) previously reported a few Yeso Group nautiloids. Terrestrial to shallow marine trace fossils and terrestrial plant fossils are also locally abundant in Yeso Group siliciclastic strata (Lucas et al., 2013).

Nevertheless, none of these fossils now known from the Yeso Group in central New Mexico are precise age indicators. Thus, stratigraphic position and regional stratigraphic relationships are the basis for assigning the Yeso an early-middle Leonardian age (e.g., Lucas et al., 2005, 2013). More open marine fossils, such as ammonoids and conodonts, are needed to determine more precisely the age of Yeso Group strata. The nautiloids reported here are such open marine fossils, and should be an inducement to search for other, open marine fossils in Yeso Group strata, particularly in southeastern New Mexico.

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