



Mesozoic stratigraphy of northeastern Chihuahua, Mexico

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MESOZOIC STRATIGRAPHY OF NORTHEASTERN CHIHUAHUA, MEXICO

by

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ABSTRACT

The area south of El Paso and the Rio Grande lies within the Chihuahua Tectonic Belt. The Chihuahua trough received as much as 2500 m of sediments from late Jurassic to late Cretaceous time. The Mesozoic rocks of the trough have been divided into ten mappable units; the upper part of the section is included in the Chihuahua Group that contains all the formations above the Cuchillo Formation up to and including the Loma Plata Limestone above; because of the frequent facies changes of the units, it is desirable to have a group to include these units. The Chihuahua Group ranges in age from early Albian to early Cenomanian.

RESUMEN

El área localizada hacia el sur de la Ciudad de El Paso y del Rio Grande está situada en la Faja Tectónica de Chihuahua. El canal de Chihuahua recibió cerca de 2500 m de sedimentos durante el Jurásico tardío hasta el Cretácico tardío. Las rocas mesozoicas del canal han sido divididas en diez unidades cartografiables; la parte superior de la sección se incluye en el Grupo Chihuahua, el cual contiene a todas las formaciones que sobreyacen a la Formación Cuchillo e incluye a la caliza Loma Plata. Debido a los frecuentes cambios de facies y a que los sedimentos albianos son transgresivos, es deseable tener un grupo que incluya a todas estas unidades. El Grupo Chihuahua varía en edad desde el Albiano temprano al Cenomaniano temprano.

STRATIGRAPHY

The area, located south of El Paso and the Rio Grande to about the latitude of Villa Ahumada ($28^{\circ} 25' N$ aprox.), Chihuahua, lies within the Province of the Sierra Madre Oriental (Guzman and DeCserna, 1963) and also within the Chihuahua Tectonic Belt of DeFord (1958). The Chihuahua trough was a negative feature from late Jurassic until late Cretaceous time, and was the site of deposition of as much as 2,500 m of sediments.

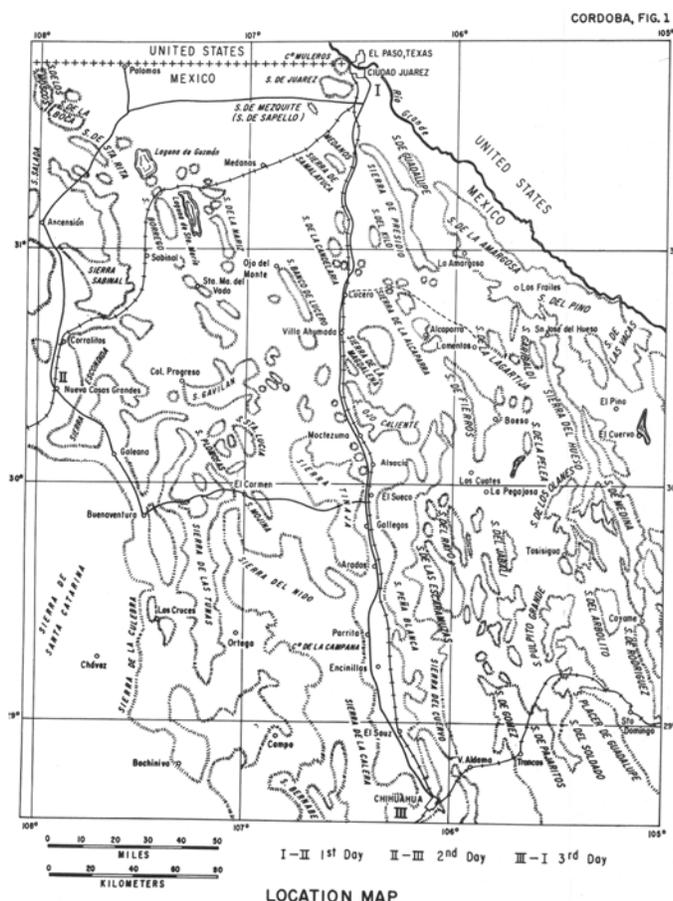
The Comanchean Series of Central Texas, extends into Northern Chihuahua, but only a few formations may be traced into Mexico, and they lose their lithostratigraphic significance as they reach the Chihuahua trough; hence the need of establishing new formation names for the units.

The Mesozoic rocks of the Chihuahua trough have been divided by several workers, although publications on the geology of the area are few. Because of numerous facies changes, the workers of the region have used many field names while working out the stratigraphy. Among these, the name "Porvenir" has been used; this term should be avoided as it is not formally proposed.

The main physiographic features or sierras in the area are: Sierra de Juarez, Sierra del Presidio, Sierra de Samalayuca, Sierra de la Alcaparra, Sierra Banco del Lucero, and others (fig. 1). The age of the rocks that crop out ranges from Late Jurassic to Early Cenomanian.

Jurassic System

Upper Jurassic rocks in northeastern Chihuahua, have been reported from immediately north of Sierra de Samala-



yuca, Sierra del Kilo, and Sierra de la Alcaparra. South of Villa Ahumada, in Sierra Ojo Caliente, recent work by Pemex geologists has demonstrated that the supposed Upper Jurassic strata that crop out there may not be Jurassic at all, but Aptian.

North of Sierra de Samalayuca a section of shale 125 m thick crops out. The shale has interbedded brownish sandstone and calcareous concretions and contains ammonites first identified as Kimmeridgian and Portlandian in age, but recent work indicates that their age is Neocomian.

On the southeast, in Sierra del Kilo, Marquez (in Ramirez and Acevedo, 1957) described argillaceous and calcareous rocks which may be Late Jurassic in age as they are reported to contain Kimmeridgian fossils. Rodriguez (1969) described, in the Aleja Creek of Sierra de la Alcaparra, a calcareous metasomatized sequence of probable Tithonian age in an incomplete section 162 m thick. This locality was reported before by Marquez (in Ramirez and Acevedo 1957 p. 688), who mentions cephalopods and bivalves similar to those observed in other Jurassic localities.

Cretaceous System

Alcaparra Formation.—The name Alcaparra Formation has been formally proposed by Rodriguez (1969) for beds of limestone and gypsum, with interbedded sandstone at the base, in Sierra de la Alcaparra (fig. 1). Aleja creek is the type locality, where he measured a 202 m thick section (description of the lithology is presented elsewhere in this guidebook). Although the unit does not contain fossils, the stratigraphic position, below the Las Vigas Formation and above the Upper Jurassic sedimentary rock, suggests an early Neocomian age for the Alcaparra. It may be correlated with the Navarrete Formation of Haenggi (1966) of the El Cuervo area, and with the pre-Las Vigas limestone of Córdoba (1966) of Sierra de los Frailes, located 45 km northeast of Sierra de la Alcaparra.

Las Vigas Formation.—The Las Vigas Formation, proposed by Burrows (1910), is a 229 m-thick section of sandstone and shale that crops out in the Chorreras area, about 82 km to the N 12° E of Chihuahua City and about 250 km southeast of Sierra de la Alcaparra. Burrows did not assign a definite age to the section; Burckhardt (1930, p. 147-148) referred these strata to the Neocomian-Aptian, because he found Jurassic fossils below and Aptian fossils above. The Las Vigas Formation crops out in many of the sierras of northeastern Chihuahua and its lithology is very persistent. It has been reported from Sierras de Boca Grande y Rica (321 m), Sierra del Presidio (850 m; Webb, this guidebook), Sierra de la Alcaparra (107 m; Rodriguez, this guidebook), Sierra de los Fierros (382 m), Sierra de la Amargosa (1957 m), and Sierra del Hueso (748 m) (fig. 1).

Cuchillo Formation.—The Cuchillo Formation was formally proposed by Burrows (1910), to describe a Conchos Valley section that overlies the Las Vigas Formation near Cuchillo Parado about 50 km west-southwest of Presidio, Texas.

R. K. DeFord (oral communication, May 1969) agreed that the name Cuchillo Formation is a better name than the many informal field names used by his graduate students in the border range in Chihuahua which faces the

Rim Rock Country in Texas (lat. 30° 00' to 30° 30'). I am using Cuchillo Formation as a formal name, in Sierra de Juarez, where I previously used "Porvenir Formation," for a thick-bedded limestone with sandstone and shale interbeds at the base, which lies between the Las Vigas Formation below and the Bluff Mesa Formation above. The upper part of the formation is a cliff-former. The Cuchillo Formation crops out extensively throughout northeastern Chihuahua. In Sierra de Juarez, I measured a section 280 m thick (1966); Caire (1966) measured 92 m in Sierra de San Ignacio; Haenggi measured 380 m, in El Cuervo area, 90 km southeast of the Juarez Mountains. In many localities of northeastern Chihuahua the lower part of the Cuchillo may have one or two thick layers of interbedded gypsum. The lower 100 m contains *Ostrea* sp. and *Exogyra quitmanensis* Cragin. From several localities I collected the following fossils (Cordoba, 1968):

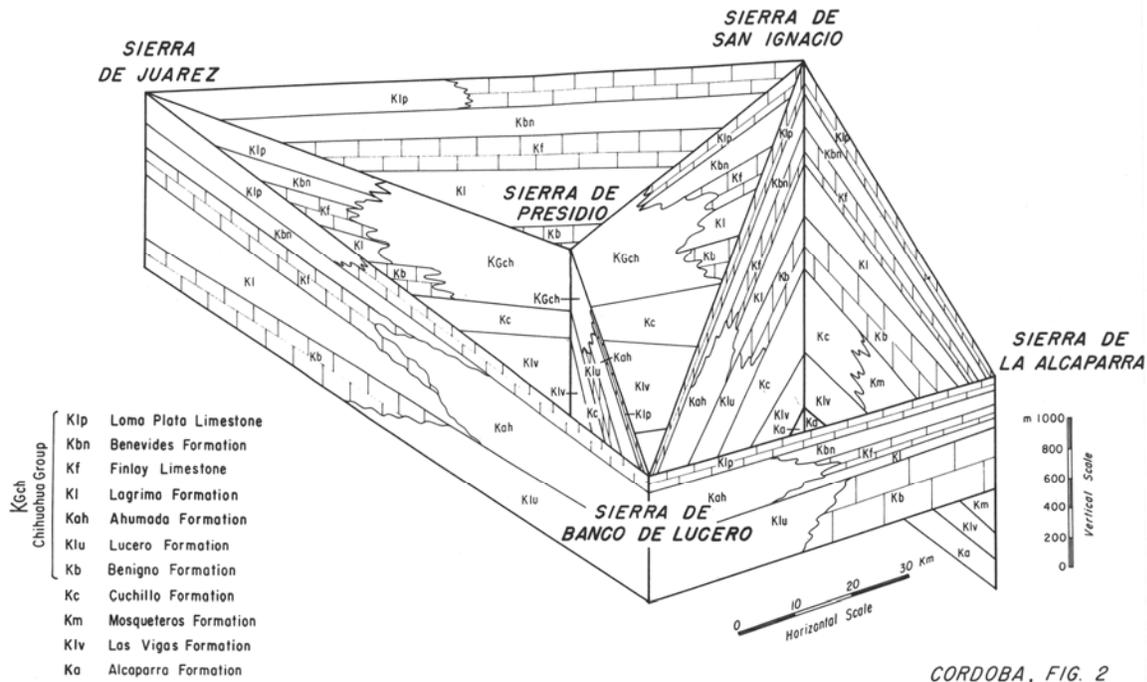
Exogyra quitmanensis Cragin
Trigonia wendleri Whitney
Trigonia stolleyi Hill
Ideonarca sp. cf. *gabrielis* Leymerie
Dufrenoyia justinae
Douvilleiceras sp.

In Sierra de San Ignacio, Caire (1966) collected *Exogyra quitmanensis* Cragin, *Ideonarca* sp., *Trigonia* sp., *Exogyra texana* Romer and *Dufrenoyia justinae*.

The presence of the Aptian ammonite *Dufrenoyia justinac* and the Albian ammonite *Douvilleiceras* sp., indicates that the Aptian-Albian boundary is within the formation, about 30 m above the *Exogyra quitmanensis* zone (Haenggi, 1966, p. 63). Thus, the age of the Cuchillo is Aptian-Albian in northeastern Chihuahua.

Although the Cuchillo lithology is persistent in the area, in Sierra de la Alcaparra there are important facies changes (see isometric diagram, fig. 2) and the name, Cuchillo, should not be used there any more. Rodriguez (1969) proposed the name Mosqueteros Formation for a calcareous sequence, partly silicified and metasomatized, that crops out in the central part of Sierra de Mosqueteros, a few kilometers north of the Sierra de la Alcaparra. The Mosqueteros Formation of Rodriguez lies in the same stratigraphic position as the Cuchillo with the Las Vigas Formation below and the Benigno above. The type section is located 6.5 Km north of Ranch No. 1, where he measured a section 380 m thick. A similar sequence has been reported from Sierra del Kilo (Sierra de Rancherías of Ramirez and Acevedo, 1957) north of Sierra de la Alcaparra and from Sierra de Ojo Caliente south of Sierra de la Alcaparra; these outcrops are mentioned in several Petroleos Mexicanos private reports (1952, Arch. Pet. Mex., in Ramirez and Acevedo, 1957), where they have been considered as a facies similar to the Torcer Formation and have been assigned the name Torcer Vigas. Ramirez and Acevedo (1957, p. 701-704) considered these outcrops as a unit they called "Rancherías" of Neocomian age, basing this assignment on a misidentified ammonite (oral communication, Tovar, 1969, recent work by Pemex geologist).

ISOMETRIC STRATIGRAPHICAL DIAGRAM



CORDOBA, FIG. 2

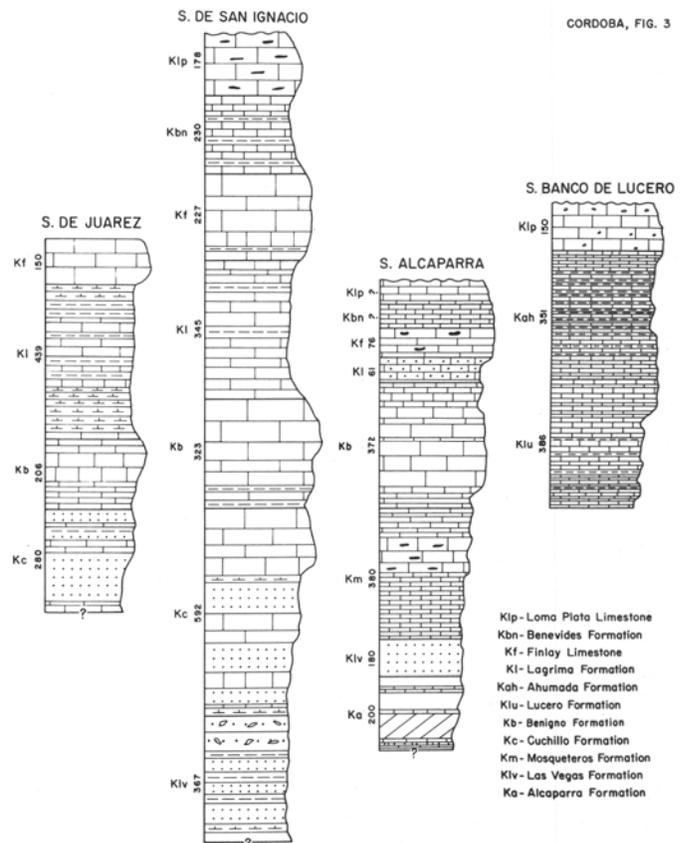
Chihuahua Group

The Chihuahua Group (Cordoba, 1969) has been proposed to include all the formations above the Cuchillo Formation up to and including the Loma Plata Limestone above, in northeastern Chihuahua. Because the Albian sediments are transgressive and because of the numerous facies changes of the units, it is desirable to have a single group to include these units. The Chihuahua Group ranges in age from early Albian to early Cenomanian.

Benigno Formation.—The name Benigno Formation has been used by Haenggi (1966) in El Cuervo area for a medium to dark gray, thick-bedded to massive cliff-forming limestone. The name has also been used by Cordoba (1968) in the Juarez mountains for 206 m of medium gray, thin- to thick-bedded limestone, whose upper part is a ridge former.

The Benigno Formation crops out extensively in northeastern Chihuahua. In the Juarez Mountains (1968) I measured a section 206 m thick, in El Cuervo area Haenggi (1966) measured 300 m, in Sierra de la Alcaparra Rodriguez (1969) measured 372 m, and Caire (1966) measured 323 m in Sierra de San Ignacio. The Benigno Formation is a cliff-forming limestone in the border range mentioned by DeFord (1958), where Haenggi (1966) used "Benigno Member" for the upper part of the Bluff Mesa.

The unit is located stratigraphically between the Cuchillo Formation below and the Lágrima Formation above; it is mainly a thin-bedded to thick-bedded limestone. The upper part is a ridge former with *Toucasia* sp.; *Orbitolina texana* Romer is found in the middle and lower parts of the formation. *Hemiaster* sp. and *Henallaster* sp. are distributed throughout. *Pecten* sp. and *Trigonia* sp. cf. *Trigonia emoryi* Conrad are found in Sierra de Juarez; besides the above



CORDOBA, FIG. 3

COLUMNAR SECTIONS OF NORTHEASTERN CHIHUAHUA

SYS TEM	SERIES	EUROPEAN STAGE	M. Y.	CENTRAL TEXAS GROUPS & FMS.	(1) SIERRA DE JUAREZ	(2) SIERRA DE SAN IGNACIO	(3) SIERRA DE PRESIDIO	(4) SIERRA BANCO DE LUCERO	(5) SIERRA DE LA ALCAPARRA	
CRETACEOUS	UPPER	GULF	MAESTRECHTIAN	72	NAVARRO GP.					
			CENONIAN	CAMPANIAN		TAYLOR GP.				
				SANTONIAN		AUSTIN GP.				
				CONIACIAN						
				TURONIAN	90	EAGLE FORD				
	LOWER	COMANCHEAN	CENOMANIAN	110	BUDA FM.	OJINAGA GP.				
			ALBIAN	UPPER		DEL RIO FM.				
				MIDDLE		GEORGETOWN FM.	CHIHUAHUA GP.	LOMA PLATA EM.	CHIHUAHUA GROUP	LOMA PLATA FM.
				LOWER	120	KIAMICHI FM.	BENEVIDES FM.	BENEVIDES FM.	AHUMADA FM.	BENEVIDES FM.
			NEOCOMIAN	COAHUILLEAN	GARGASIAN		EDWARDS FM.	FINLAY FM.	FINLAY FM.	
	BEDOULIAN				PEAK FM.	LAGRIMA FM.	LAGRIMA FM.		LAGRIMA FM.	
	BARREMIAN				COAHUILLEAN FM.	BENIGNO FM.	BENIGNO FM.	LUCERO FM.	BENIGNO FM.	
	HAUTERIVIAN				WALNUT FM.					
	VALANGINIAN				PALUXY FM.					
	JURASSIC	UPPER	SABINIAN	BERRIASIAN	135	GLEN ROSE FM.				
NEOCOMIAN					COW CREEK FM.					
VALANGINIAN					HAMMET FM.	CUCHILLO FM.	CUCHILLO FM.	CUCHILLO FM.	MOSQUETEROS FM.	
HAUTERIVIAN										
BARREMIAN					SLIGO FM.		LAS VIGAS FM.	LAS VIGAS FM.	LAS VIGAS FM.	
BEDOULIAN					HOSSTON FM.					
GARGASIAN										
TITHONIAN										
KIMMERIDGIAN										
OXFORDIAN										

Diagonal lines indicating non-out cropping units
 Vertical lines indicating missing units.
 (1) D. A. Córdoba (2) L. F. Coire (3) D. S. Webb
 (4) J. Guerrero (5) R. Rodríguez T.

CORRELATION OF MESOZOIC ROCKS OF NORTHEASTERN CHIHUAHUA, MEX.
 BY DIEGO A. CORDOBA M. AND RAFAEL RODRIGUEZ TORRES

mentioned fossils, *Loriola* sp. cf. *rosana* Cooke has been found in Sierra de San Ignacio.

The lowermost stratigraphic unit that crops out in Sierra Banco de Lucero, located 15 Km northwest of Villa Ahumada, Chihuahua, has been formally proposed by Guerrero (1959), as the Lucero Formation. The Lucero Formation, a 386 m thick calcareous-argillaceous sequence, represents a facies change of the Benigno (see isometric diagram, fig. 2); it contains echinoids as well as other unidentified fossils. This section is similar to the Sierra de Presidio section, that crops out above the Cuchillo Formation (Webb, this guide-book). Both sections are equivalent to the Benign() of nearby sierras.

The Albian age of the Benigno is indicated by *Orbitolina texana* Romer, other fossils, and by its stratigraphic position above and below formations of definite Albian age.

Lágrima Formation.—The name Lágrima Formation has been used by Córdoba (1968) in the Juarez Mountains; and is based on Haengi's section (1966) in the El Cuervo area. The unit is stratigraphically above the Benigno Formation and is widely spread throughout northeastern Chihuahua. The formation is mainly light gray, shaly, nodular, thin- to thick-bedded, micrograined limestone.

This same unit has been mapped by several geologists with informal names such as "Cedillo." Thickness of this

unit in the area is 490 m in Sierra Lágrima, 339 m in Sierra de Juárez, 393 m in Sierra de San Ignacio. The Lágrima Formation is a facies gradation of the Cox sandstone of Trans-Pecos Texas and other sierras of northeastern Chihuahua. In Sierra de la Alcaparra, Rodríguez described a thin section of the Lágrima Formation, with a *Exogyra texana*, *Tylostoma* sp. and several horizons of *Orbitolina* sp. In Sierra de Juárez, the lower member of the Lágrima contains abundant *Orbitolina texana* Romer and *Caprinuloidea* sp. In Sierra Banco de Lucero, the Lágrima Formation grades into the lower part of the Ahumada Formation (see isometric diagram, fig. 2). In Sierra del Presidio, the Lágrima Formation represents probably about the middle part of the exposed section of the Chihuahua Group. In both sierras the lithostratigraphic identity of the Lágrima has been lost, and it is not an easily differentiated mappable unit.

The Lágrima Formation is underlain and overlain by Albian formations and also contains *Orbitolina texana* Romer, thus the age of the Lágrima is Albian.

Finlay Limestone.—The Finlay Limestone was formally proposed by Richardson (1904) for a 100 m thick sequence of massive limestone with thin-bedded sandstone interlayers. The formation crops out in the Finlay Mountains. A

type locality recently proposed by Brunson (1954, p. 37) is located in Flat Canyon, at the northern rim of the Finlay Mountains. The Finlay Limestone is 130 m thick in the Juarez Mountains (Cordoba, 1968) and 75 m thick in Sierra de la Alcaparra. In Trans-Pecos Texas the Finlay Limestone rests disconformably on the Cox Sandstone (Underwood, 1963; Brand and DeFord, 1958 p. 376); however, in northeastern Chihuahua this disconformity has not been found. The Finlay Limestone contains abundant *Dictyonotus wallnutensis* (Carsey) 40 m above the base of unit. The lower part of the Finlay has *Toucasia* sp. and *Caprinuloidea* sp. The lower beds have *Exogyra* sp. and *Ostrea* sp. In addition, I have collected *Gryphaea mucronata* Gabb, and *Lunatia* sp. and *Pecten* sp. from the lower beds at Sierra de Juarez.

The age of Finlay Limestone is Albian because it is between Albian formations.

The Finlay Limestone in Sierra Banco de Lucero is probably represented by the middle part of the Ahumada Formation (see isometric diagram, fig. 2.)

Benevides Formation.—The Benevides Formation was proposed by Amsbury (1957) for a 50 m section of dark gray shale and yellowish calcarenite that crops out near Rancho Benevides in the Pinto Canyon area, Presidio County, Texas.

Underwood (1963) mapped the formation between the Finlay and Espy Limestone as Benevides in the Eagle Mountains and vicinity. Haeggi (1966) mapped the same unit in the El Cuervo area, Rodriguez, (1969) in Sierra de la Alcaparra, and I in the Sierra Juarez.

The measured thicknesses of the Benevides are 260 m in the El Cuervo area, 40 m in the Eagle Mountains, 220 m in Sierra de San Ignacio, and 180 m in Sierra del Hueso. R. K. DeFord's graduate students measured 243 m, 154 m, and 212 m in three different parts of the Sierra Pilares, in the border range in Chihuahua (1958).

The Benevides has yielded a large number of fossils and in the above mentioned localities different workers have collected:

Bendanticeras sp. cfr. *B. beudanti* (Hitzel)
Eopachydiscus sp.
Pervinquiera equidistans (Cragin)
Venezoliceras sp. cfr. *V. trinitense* Gabb
Adkinsites bravoensis (Bose)
Idiohamites fremonti (Marcou)
Manuaniceras sp. aff. *M. multifidum* (Steinmann)
Prohysterocheras sp. cfr. *P. austinense* (Romer)
Adkinsites diazi Young
Diploceras sp. cf. *D. fredericksburgense* Scott
Craginites serratescens (Cragin)
Oxytropidoceras bravoense
Exogyra texana Römer
Pecten sp.
Nerinea sp.
Epiaster sp.
Caprinuloidea sp.

The ammonites from the Benevides in northeastern Chihuahua indicate that the formation is middle to late Albian in age.

The Benevides lithology wedges out and in Sierra Banco

de Lucero is probably represented by part of the Lucero Formation (see isometric diagram fig. 2).

Loma Plata Limestone.—Amsbury (1957) proposed this name for a sequence 240 m thick of gray, nodular, limestone that crops out in the Pinto Canyon area in Presidio County, Texas where it is interbedded with massive limestone with chert stringers and several rudistid horizons.

In northeastern Chihuahua the strata above the Benevides Formation are lithologically similar to Amsbury's Loma Plata. The limestone contains abundant *Caprinuloidea* sp. and *Enhallaster* sp. as well as numerous unidentified gastropods; none of these fossils is suitable to assign a definite age to the unit.

The Loma Plata Limestone is 500 m thick at El Cuervo area, 178 m in Sierra de San Ignacio, about 100 m in Sierra de la Alcaparra, and 150 m in Sierra Banco de Lucero. The section exposed at El Cuervo is overlain by the Del Rio Formation but the upper part of the Loma Plata in many sierras has been eroded.

The age of the Loma Plata Limestone is Late Albian-Early Cenomanian; it is underlain by Albian beds (Benevides Formation) and overlain by Early Cenomanian beds (Del Rio Formation); the Albian-Cenomanian boundary is within the formation. Loma Plata is a continuous body in northeastern Chihuahua and may be correlated with the Espy Limestone of the Eagle Mountains.

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