STRATIGRAPHIC CORRELATION OF THE EL PASO AND MONTOYA GROUPS IN THE VICTORIO MOUNTAINS, THE SNAKE HILLS, AND THE BIG FLORIDA MOUNTAINS IN SOUTHWESTERN NEW MEXICO

by

C. George Lynn

A Thesis Submitted to the Faculty of the

DEPARTMENT OF GEOSCIENCES

In Partial Fulfillment of the Requirements
For the Degree of

MASTER OF SCIENCE

In the Graduate College

THE UNIVERSITY OF ARIZONA

1 9 7 5

STATEMENT BY AUTHOR

This thesis has been submitted in partial fulfillment of requirements for an advanced degree at The University of Arizona and is deposited in the University Library to be made available to borrowers under rules of the Library.

Brief quotations from this thesis are allowable without special permission, provided that accurate acknowledgment of source is made. Requests for permission for extended quotation from or reproduction of this manuscript in whole or in part may be granted by the head of the major department or the Dean of the Graduate College when in his judgment the proposed use of the material is in the interests of scholarship. In all other instances, however, permission must be obtained from the author.

SIGNED: C. George Lynn

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Joseph F. Schreiber, Jr. July 9, 1975

JOSEPH F. SCHREIBER, JR. Date
Professor of Geosciences

ACKNOWLEDGMENTS

I would like to thank Dr. Joseph F. Schreiber, Jr., for his assistance and guidance during the completion of this thesis. Thanks are also extended to Dr. Dietmar Schumacher for critically reviewing the manuscript and making many helpful suggestions.

I am greatly indebted to Dr. Rousseau H. Flower for his assistance in fossil identification and stratigraphic correlation.

Special thanks go to my mother and father, and especially to my lovely wife, Nancy, for her patience and encouragement throughout this study.

TABLE OF CONTENTS

TABLE OF CONTENTS--Continued

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS--continued

ABSTRACT

The Ordovician El Paso and Montoya Groups in southwestern New Mexico consist primarily of argillaceous limestones and secondary dolomites. The original sediments are chiefly the product of deposition in a nearshore, shallow water marine environment, with some indication of intertidal deposition. Calcarenites and calcilutites containing bioclastic debris, intraclasts, oolites and channel fillings dominate the section.

Exposures of Ordovician strata in the Victorio Mountains, the Snake Hills, and the Big Florida Mountains in Luna County, New Mexico, were measured and described in detail. Samples collected in the field were described further in the laboratory by standard petrographic methods. Correlation among the three field areas and with other localities in southwestern New Mexico and west Texas is based on lithologic boundaries and biostratigraphic units recognized in the field and through the laboratory studies.

Insoluble residues recovered from individual units furnished supplemental data and thus aided in correlation. In some instances, however, they provided an insight to depositional and diagenetic processes which were not apparent during other methods of analysis.

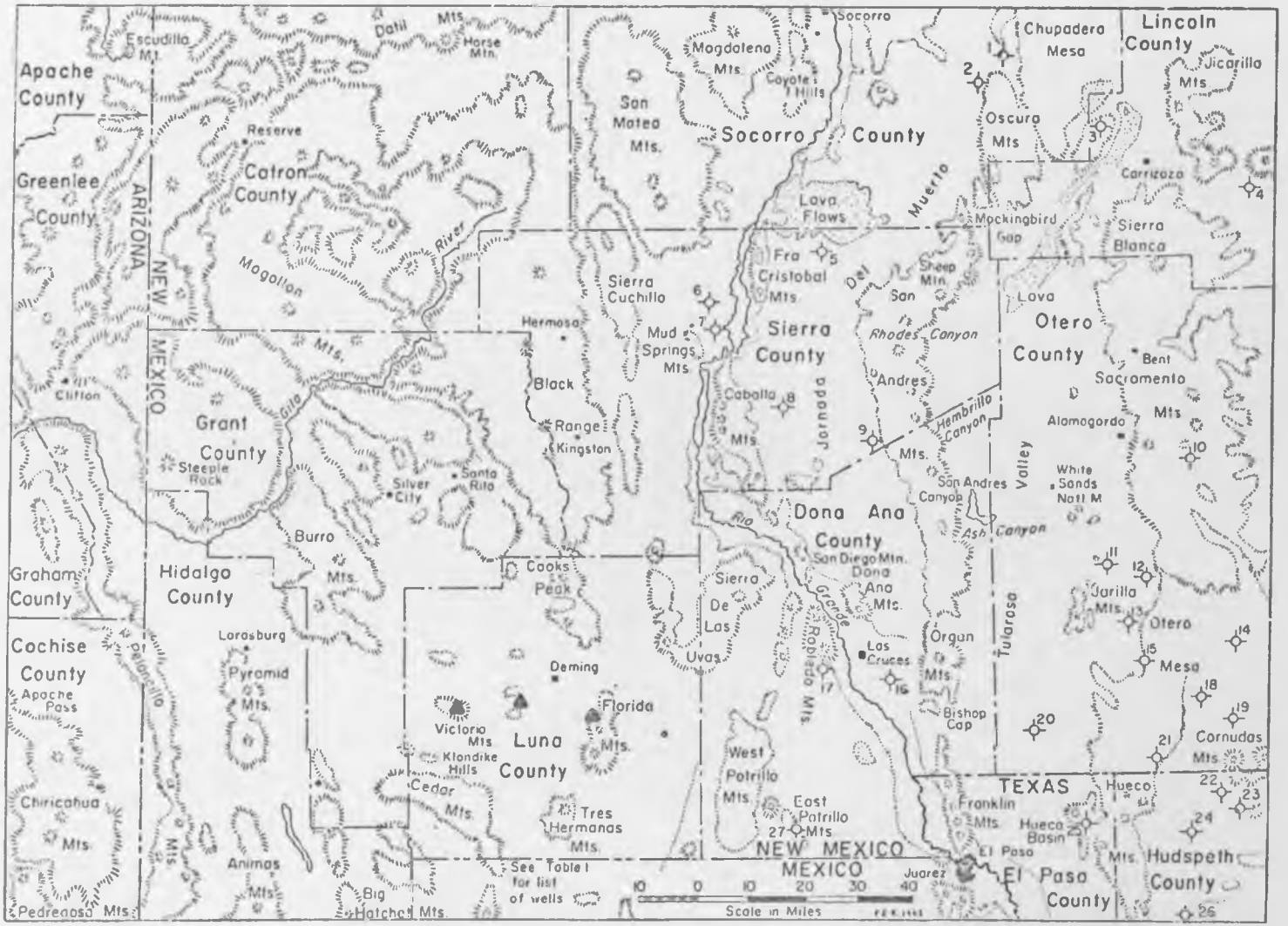
INTRODUCTION

Purpose

The need for detailed stratigraphic analysis of the El Paso and Montoya Groups in the Victorio Mountains, the Snake Hills, and the Big Florida Mountains in southwestern New Mexico is an outgrowth of field-work conducted by the author during five months in 1974 for a major minerals exploration company. Although a working knowledge of the lower Paleozoic stratigraphy of the area had been developed during the summer, a more detailed understanding of the local stratigraphy was required. This information was not available in the literature because previous work has been limited to reconnaissance mapping and some stratigraphic measurements and descriptions. This thesis, therefore, deals with the detailed stratigraphic analysis and correlation of the El Paso and Montoya Groups in the three field areas.

Location

The Victorio Mountains, the Snake Hills, and Big Florida Mountains are located near Deming, New Mexico in Luna County, just south of Interstate 10 and within 20 miles of each other (Fig. 1). Although the three localities differ somewhat markedly in terms of general topographic expression, they share the characteristic of rising up abruptly from the surrounding Sonoran desert plain. They represent block-faulted mountains in the Mexican Highland section of the Basin and Range Province.



▲ - measured section

Fig. 1. Index map showing the location of measured sections. (Adapted from Kottlowski, 1963, p. 3)

Previous Work

Lindgren, Graton, and Gordon (1910) described the mineral occurrences in the Victorio and Big Florida Mountains, but made little mention of the local stratigraphy. In 1954, H. L. Jicha recognized El Paso and Montoya Group rocks in the Victorio Mountains. Balk (1958) described the stratigraphic section at Capitol Dome on the northwest flank of the Big Florida Mountains, from basal Precambrian granite to the Tertiary volcanics which form the dome itself. Kottlowski (1961) and Kottlowski and LeMone (1969) have measured Ordovician sections in these and other localities in New Mexico and west Texas.

Flower (1957, 1961, 1964, 1965, 1968), in his exhaustive studies of Paleozoic faunas, has collected in the three field areas and has pioneered much of the correlation through fossil evidence.

METHODOLOGY

Fieldwork

Stratigraphic sections were measured and described where exposures of strata were continuous and relatively free from faulting and/or brecciation. Slopes and bedding attitudes were such that individual units could be measured directly with a ten foot tape or by means of a Brunton pocket transit. Each unit was described according to lithology, color, texture, outcrop characteristics, and associated fauna. A flow sheet with these headings served as the format for gathering data in the field, and later provided a convenient method for comparison of strata (Fig. 2). Each unit was sampled to ensure that sufficient material was available for fossil identification, binocular and petrographic microscope examination, and the concentration of insoluble residues by digestion in hydrochloric acid.

Laboratory Procedure

Work in the laboratory began with sawing each hand specimen and then etching the smooth surface with hydrochloric acid to determine the general lithology, recognize recrystallization and dolomitization, and accentuate fossil fragments. Thin sections were made when it was deemed necessary to study unusual structures or microcrystalline textures in more detail.

Portions of the sawed specimens were crushed to approximately 20 mesh (1/4 inch) by a jaw crusher and rolls for digestion in dilute

Unit	Rock Name and Composition	Grain Size	Color		Outcrop and Bedding	Fossils and Structures	Comments
			Fresh	Weathered			

Fig. 2. Flow sheet used for recording field data.

hydrochloric acid. Ten grams of each sample were placed in a beaker and 100 milliliters of 15 percent acid were slowly added. (Note that the crushed material is measured by weight and not by volume, because soft and friable samples can be crushed into small, uniform-sized particles, while denser and more siliceous specimens are reduced to coarse, angular fragments. Thus, for a given unit of volume, the actual amount by weight of crushed rock can vary significantly due to particle size and sorting, which will ultimately be reflected in the amount of insoluble residue.)

After this initial digestion, the spent acid was poured off and another 100 milliliters added to ensure complete digestion of carbonate material. The final residue was decanted, washed with distilled water, and allowed to dry by evaporation.

Systematic weighing of the beaker and residue yielded the total amount of insoluble material contained in each unit, which was further subdivided into coarse and fine fractions using a 4 ϕ wet sieve. The resulting percentages were plotted on the stratigraphic columns with appropriate symbols, as shown in Fig. 3 (in pocket).

REGIONAL STRATIGRAPHY

El Paso Group

The El Paso Limestone was originally named by Richardson (1904) for exposures in the southern Franklin Mountains. The term has been used for similar beds east of the Franklin Mountains in the Hueco Mountains, north into south-central New Mexico, west into Cochise County, Arizona, and south into Old Mexico. Kelley and Silver (1952) raised the formation to group status and employed a twofold classification for the limestone; the lower Sierrite Limestone and the upper Bat Cave Formation (Fig. 4). Flower (1957) later subdivided the Canadian series into four stages: the Gasconadian, the Demingian, the Jeffersonian, and the Cassinian. In 1964, Flower proposed ten formation names--Sierrite, Big Hatchet, Cooks, Victorio Hills, Jose, Mud Springs Mountain, Snake Hills, McKelligon, Scenic Drive, and Florida Mountains--for the El Paso Group, using distinct faunal zones and lithologic boundaries.

Sierrite Formation

The base of the El Paso Group is a transition zone between the Bliss Sandstone and the overlying limestone beds. The type section described by Kelley and Silver (1952) is exposed on the southwestern side of Cable Canyon in the Caballo Mountains, Sierra County, New Mexico (sec. 10, T. 16 S., R. 4 W.).

In the Franklin Mountains, LeMone (1967) subdivided the Sierrite Formation into a basal Transition Zone, 20 feet of cross-bedded

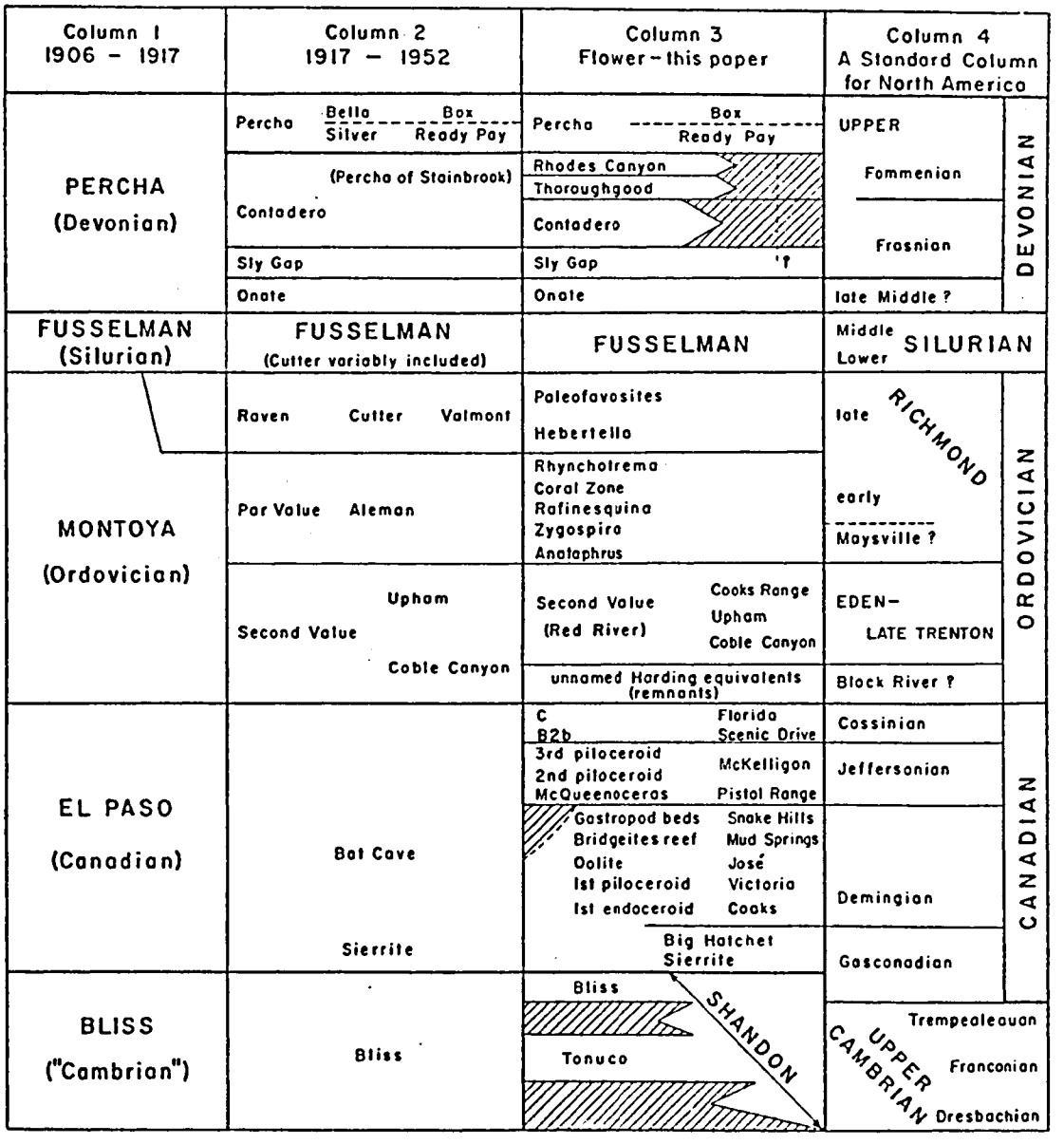


Fig. 4. Development of formational units in New Mexico.

(Adapted from Flower, 1965, p. 116.)

dolomitic sandstone, and the upper Wavy Bedded Member, 101 feet of sandy calcilutitic dolomite. This bipartite development of the Sierrite Formation is not evident in the Hatchet Mountains where massive dolomites predominate. In general, sand and glauconite persist in the base of the Sierrite, decreasing upward into the overlying dolomites.

Fossils are poorly preserved due to dolomitization, but include Apheoorthis, Lytospira gryocera, and Symphysurina. Other forms present are the large gastropod Ophileta, brachiopods related to Finkelnburgiae, and Girvanella represented as spheroidal algae in the upper layers (Flower, 1968).

Big Hatchet Formation

Flower (1964) named the Big Hatchet Formation for a massive dolomite and interbedded shales sequence exposed on the northwest side of Mescal Canyon in the northern Big Hatchet Mountains, Hidalgo County, New Mexico (SW 1/4 sec. 29, T. 30 S., R. 15 W.). The Victorio Mountains are the only other known location of this formation, possibly because elsewhere it is absent due to erosion or nondeposition (Kottlowski and LeMone, 1969). Flower (1968) divided the Big Hatchet Formation into a lower zone of interbedded massive dolomite and dolomitic shales, and an upper thick sequence (288 feet) of massive dolomite with abundant spheroidal, white-weathering chert.

Dominant fossils in the Big Hatchet Formation include Kainella, Leiostegium, Hystricurus, and brachiopods considered to be Nanorthis and Apheoorthis. The Apheoorthis finkelnburgiae zone described by Flower

(1968) in the east may be equivalent to the Big Hatchet Formation, although precise correlation has not yet been demonstrated.

Cooks Formation

The Cooks Formation contains the first endoceroid zone described by Flower (1964), and is marked by the appearance of endoceroid cephalopods in the El Paso Group. The type section is located on the northern end of the Cooks Range in Luna County, New Mexico (sec. 11, T. 20 S., R. 9 W.).

With the exception of the Franklin Mountains where the Cooks Formation is dolomite, light-colored calcilutitic and calcarenitic limestones comprise the section, with some nodular chert, silicified worm trails, stromatolites, and fossil hash. Silicified siphuncles belonging to Clitendoceras and Proendoceras are the most common fossils present. The brachiopod Diaphelasma, small gastropods of the aspect Ophileta and Ozarkina, and occasional Evansapsis trilobite fragments also occur. The Cooks Formation reaches a maximum thickness of 109 feet in the Franklin Mountains, but does not exceed 80 feet in New Mexico.

Victorio Hills Formation

The Victorio Hills Formation consists of massive, dark-weathering calcilutitic limestones with stromatolitic reefs and conglomeratic beds. This includes the first piloceroid zone described by Flower (1964) and was originally identified in the East Hills of the Victorio Mountains, Luna County, New Mexico (SE 1/4 NE 1/4, sec. 28, T. 24 S., R. 12 W.).

The dominant fossils are piloceroid siphuncles which can be distinguished from siphuncles in the first endoceroid zone by their

larger size, advanced curvature, and rapid expansion (Flower, 1968). Sponge fragments are abundant for the first time in the section, while Diaphelasma, gastropods, and occasional Evansapsis specimens are found locally. In the Franklin Mountains the Victorio Hills Formation is 290 feet thick, but the same formation rarely exceeds 100 feet in New Mexico.

Jose Formation

The most conspicuous formation in the El Paso Group is the Jose Formation, characterized by black oolitic limestones and channel fill deposits laden with fossil hash and black pebble conglomerates. Kuellmer (1956) located the type section in sec. 11, T. 20 S., R. 9 W., Luna County, New Mexico, but Flower (1964) proposed the formation name for the Jose mining district in the Cooks Range. The oolite zone is commonly 30 to 40 feet thick in New Mexico, but is over 70 feet thick in the southern Franklin Mountains (Kottlowski and LeMone, 1969).

The abundance of oolites and disarticulated fossil debris is attributed to shifting shallow marine environments. The presence of dark, fetid limestone suggests that restricted embayment conditions also existed for short periods of time. Pygidia and free cheeks of asaphid trilobites are the most prevalent fossil remains, along with discoidal gastropods (Bridgeina), brachiopods, slender cephalopods, and digitate algae.

Mud Springs Mountain Formation

The Mud Springs Mountain Formation is separated from the Jose Formation by a few feet of transitional calcilutites. Flower (1964) designated this formation his Bridgeites reef for a massive,

gastropod-rich sequence of strata exposed on the southwestern flank of Mud Springs Mountain, Sierra County, New Mexico (sec. 25, T. 13 S., R. 2 W.). The reef consists of 20 to 30 feet of light-weathering, cliff-forming, stromatolitic limestone, which contains the large flat gastropod Bridgeites. The Mud Springs Mountain Formation can be recognized in most El Paso sections in southwestern New Mexico, but either through erosion or nondeposition the formation is absent in the southern Franklin Mountains.

Snake Hills Formation

The Snake Hills Formation consists of thin-bedded calcilutites, relatively chert-free, with variable amounts of fossil debris. Small high and low spired gastropods are present; the only identifiable fossils belong to the trilobite Leiostegium (Flower, 1968). The type section is located in the Snake Hills about 10 miles southwest of Deming in Luna County, New Mexico (sec. 33, T. 24 S., R. 10 W.).

The maximum observed thickness of 60 feet was measured in the Cooks Range. The Snake Hills Formation is considered the youngest unit of Middle Canadian age in the El Paso Group.

McKelligon Canyon Formation

The McKelligon Canyon Formation is a massive limestone sequence of stromatolitic calcilutites and biohermal beds. The type locality is one mile west and 1500 feet south of the intersection of longitude 106° 27' 30" and latitude 31° 47' 30" (El Paso, Texas, 7.5 - minute quadrangle, 1955) (Kottlowski and LeMone, 1969).

The basal layers of the McKelligon Canyon Formation belong to the Pistol Range Member and are characterized by 30 feet of sand and dolomite in the southern Franklin Mountains. Overlying the Pistol Range Member are 675 feet of alternating stromatolitic beds and massive and thin-bedded limestones, although in New Mexico the stromatolitic beds are not well developed.

Flower (1964) correlated his 2nd and 3rd piloceroid zones with the McKelligon Canyon Formation, based on the abundance of piloceroid siphuncles found throughout the formation. Sponges, gastropods, trilobites, and brachiopods are also present, and in west Texas Pulchrilamina mounds are common.

Scenic Drive Formation

The Scenic Drive Formation as described by Flower (1964) consists of a sandy dolomite, dolomite, and limestone sequence. The type locality lies directly above the type section of the McKelligon Canyon Formation. In the southern Franklin Mountains the base of the formation is characterized by cross-bedded dolomitic sandstones, passing upwards into arenaceous dolomites, and finally capped by 200 feet of thin-bedded limestones. The basal layers belong to the Black Band Dolomite Member and consist of about 60 feet of dark sandy dolomites. This member yields abundant silicified fossils, especially Ceratopea gastropods, some cephalopods, including Tarphyceras, and occasional pelecypod fragments.

The overlying Nameless Canyon Member is composed of thin-bedded calcilutitic limestone with abundant orange-weathering chert. Faunal

remains are silicified, and include brachiopods, gastropods, (Ceratopea), trilobites, and sponges.

Florida Mountains Formation

The youngest Canadian and highest El Paso strata belong to the Florida Mountains Formation, named by Flower (1964) for rocks expressed in the east-central Florida Mountains, Luna County, New Mexico (sec. 6, T. 26 S., R. 7 W.). Calcarenites dominate the section in both the Florida and southern Franklin Mountains, but these are interbedded with calcilutites in the Florida Mountains and with orange-weathering siltstones in the southern Franklins.

The formation is about 35 feet thick and contains an abundant and diverse fauna, consisting of Buttsoceras and Michelinoceras cephalopods, large brachiopods including Syntrophopsis and Tritoechia, and some smaller Diaparalasma. Trilobites, sponges, and pelmatozoan fragments are also present, along with the gastropods Maclurites and Hormotoma.

Montoya Group

Richardson (1908) first proposed the name Montoya for a sequence of Upper Ordovician strata exposed near El Paso. Entwistle (1944) divided the Montoya into the Second Value, Par Value, and Raven members, but Kelley and Silver (1952) recognized stratigraphic discontinuities and revised Entwistle's terminology.

The present formation names, Cable Canyon Sandstone, Upham Dolomite, Aleman Formation, and Cutter Formation, are taken from stations along the Santa Fe Railway. The type section of the Montoya Group crops

out in Cable Canyon opposite the Sierrite Mine, Caballo Mountains, Sierra County, New Mexico (NW 1/4 sec. 10, T. 19 S., R. 4 W.) (Kottlowski and LeMone, 1969).

The Montoya Group has been studied extensively by Richardson (1908, 1909), Nelson (1940), Pray (1958), Flower (1957, 1961), and Howe (1959). The extreme lateral lithic variation is in part the result of three, possibly four, periods of deposition separated by intervals of erosion, and also by widespread recrystallization and dolomitization. The basal Cable Canyon sandstone can range from 0 to 30 feet thick in less than 100 yards laterally, and although the Montoya Group is primarily dolomite, at Cooks Peak and in the Hueco Mountains limestone only comprises 50 percent of the section.

Flower (1957, 1961) has identified a variety of fossils associated with Montoya Group rocks. The most notable of these are cephalopods, coelenterates and attached organisms, and gastropods which he has correlated with post-Canadian Ordovician faunas in Colorado, Winnipeg, Hudson's Bay, and Greenland.

Cable Canyon Sandstone

The Cable Canyon Sandstone rests uncomformably on the El Paso Group, forming an abrupt, distinct contact between the light gray El Paso limestone and the dark-weathering Cable Canyon sandy dolomite. The Cable Canyon Sandstone forms a conspicuous, dark-brown massive cliff which is usually visible from a distance. In most localities the formation is light gray to medium gray, weathering dark grayish brown in massive to thick-bedded cliffs. The sands are poorly sorted, commonly

rounded and frosted, and decrease rapidly upward until only scattered grains persist in the lower Upham Dolomite.

Great thickness variations exist in the Cable Canyon Sandstone, which Flower (1965) attributes to pre-Upham erosion. Others have suggested that post-El Paso karstification explains the variable thicknesses and that the Cable Canyon Sandstone grades directly into the overlying Upham Dolomite.

The Cable Canyon Sandstone represents marine clastics deposited and reworked in shallow Red River age seas; the source area was a low positive region located in the north near Catron County (Fig. 1). Sparse faunal remains are a reflection of the high energy environment responsible for the accumulation of the coarse Cable Canyon sands, but Flower (1961) has identified Maclurina, rare endoceroids, and Receptaculites fragments.

Upham Dolomite

The Upham Dolomite appears gradational from the Cable Canyon Sandstone and commonly contains sandy lenses near the base. The Upham is a massive, cliff-forming sequence of dark gray dolomites with little or no evidence of original bedding preserved. Prior to dolomitization the Upham Formation was probably a crinoidal calcarenite, as suggested by Red River fauna and occasional unaltered sections, such as the representative limestone at Cook's Peak.

Flower (1965) further subdivided the Upham into three Lithic Units: (1) lower dark massive beds; (2) middle calcarenites which are thin, light-colored and crinoidal to the east, but thicker and darker

with abundant brachiopods in the west; and (3) an upper massive layer which may contain irregular to rounded chert nodules. Thickness of the Upham Dolomite is relatively uniform in New Mexico and west Texas, ranging from 70 to 110 feet, except where beveled by post-Montoya erosion. Red River age fauna dominates the section, and includes Receptaculites, Maclurites and Hormotoma, trilobites, brachiopods, coelenterates, and cephalopods.

Aleman Formation

The Aleman Formation equates with Entwistle's Par Value Member, and is the most conspicuous formation in the entire Lower Paleozoic. Interlayered banded chert and dolomite typify the section, with a general increase in chert and a decrease in dolomite upsection. The chert weathers white to burnished red in strong relief against the less resistant light to medium gray dolomite, and could represent primary (or at least penecontemporaneous) deposition of silica in a restricted marine environment.

The Aleman Formation rests discomformably on the Upham Dolomite, and ranges from 70 to 200 feet in thickness. Limestone exists locally in the section, but where dolomitization is advanced, silicified fossils are the only remnants of the original depositional environment.

Flower (1957) subdivided the Aleman into four zones: (1) basal Zygospira; (2) Rafinesquina; (3) Rynchotrema capax; and (4) the uppermost "megaripple" zone. In addition to the faunas for which each zone is named, an abundance of corals, brachiopods, bryozoans, and trilobites can be found throughout the section. The "megaripple" zone contains only a

sparse fauna, and is restricted to exposures in the northern and eastern sections.

Cutter Formation

At the top of the Montoya Group is the Cutter Formation, a light to medium gray, fine-grained dolomite previously called the Valmont Dolomite by Pray (1953) and the Raven Member by Entwistle (1944). The Cutter is separated from the Aleman Formation by a minor disconformity, and ranges from 150 to 210 feet thick where not thinned by post-Montoya erosion.

Chert nodules are scattered near the base of the sequence, but decrease upward in both size and number. Faunal remains are sparse, but Flower (1965) lists one to three zones based on silicified corals, mainly Paleofavosites, and a nonresistant siltstone yielding pelecypod and brachiopod fragments.

LOCAL STRATIGRAPHY

Victorio Mountains

The Victorio Mountains, located due south of Gage, New Mexico, are composed of Tertiary volcanics in the north and west, and Lower Paleozoic sediments in the south and east (Fig. 1). The El Paso Group is exposed in the East Hills (Griswold, 1961), where the most complete section is 504 feet thick (Fig. 5). The base of this section is a near-bedding plane fault which locally transects bedding planes and climbs up through the section from southeast to northwest. The fault is characterized by silicified breccia, and brings Montoya (Cable Canyon and Upham) Group rocks in contact with the El Paso limestone on the northwest flank of the East Hills. Minor breccia stringers extend out from the main fault zone, and locally some skarnification has occurred adjacent to the main fault.

Bedding in the lower units is disrupted and erratic because of local folding and faulting. In general, a N. 65° W., 24° SW. attitude of the bedding is maintained throughout the El Paso Group on the East Hills.

The Montoya Group crops out on the north side of Mine Hill, although extensive faulting has disrupted the section and nowhere is there a continuous exposure. All four formations of the Montoya Group are present, but silicification related to faulting and mineralization of the overlying Silurian Fusselman Dolomite have significantly altered much of the original lithology. As much as 389 feet of Montoya Group

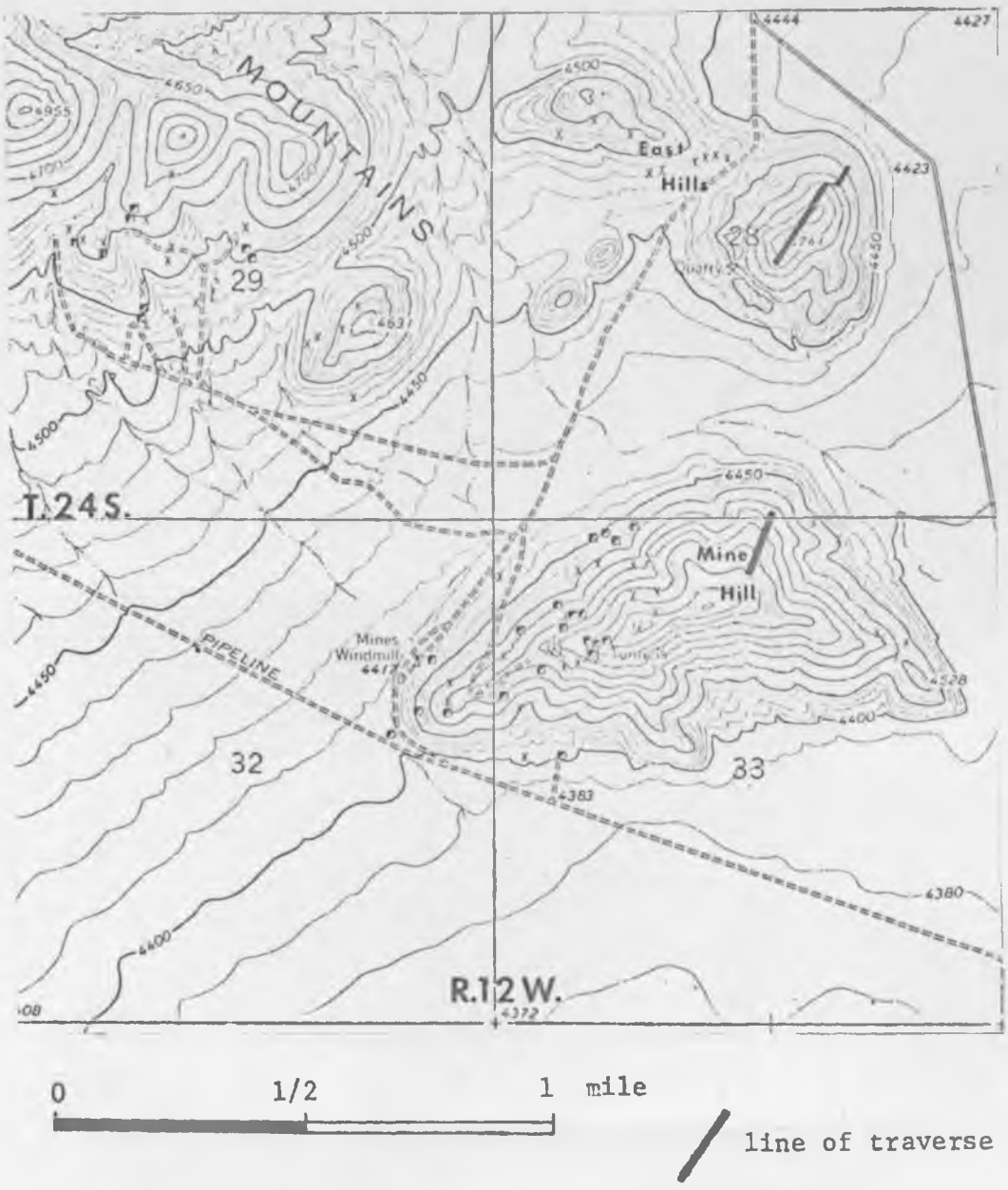


Fig. 5. Location map of measured sections in the Victorio Mountains, Luna County, New Mexico.

(Gage, New Mexico, 7.5 - minute quadrangle, 1963).

rocks are exposed on Mine Hill. However, this figure varies down to 360 feet because of post-Ordovician, pre-Silurian erosion of the Cutter Formation.

El Paso Group

The El Paso Group is well exposed on the largest hill in the East Hills (Fig. 6). The section includes the Big Hatchet Formation at the base, and continues up through the Mud Springs Mountain Formation (Fig. 3). Minor faulting is ubiquitous, but strata are well exposed and a continuous section can be measured from the base to the top of the hill.

The oldest formation exposed in the Victorio Mountains is the Big Hatchet Formation. Thin-bedded, silty, calcilutitic to calcarenitic limestone is the dominant lithology, forming a continuous series of one to four-foot step-like ledges. Fine-grained, subhedral quartz is especially abundant near the base of the formation, and appears to be an overgrowth on clear sand. The upper two units contain dolomoldic chert localized in irregularly shaped pods and lenses (Fig. 7). Eleven and one-half feet above the base of unit 4 is a small two-foot dioritic to diabasic sill that is only locally exposed on the northeast side of the hill, but can easily be traced on the quarry wall located on the southwest side of the East Hills (Fig. 6).

Anastomosing burrow casts weather in strong relief on bedding planes throughout the Big Hatchet Formation, and appear to be silicified or at least concentrations of silty or sandy material. Fossil remains are rare, and what is present is too small for adequate identification. Local diagenesis has altered the calcilutite by recrystallization to a

Fig. 6. The East Hills in the Victorio Mountains, as seen from Mine Hill.

(Note limestone quarry in left foreground.)

Fig. 7. Chert pods and lenses weathering in relief in unit 4 of the Big Hatchet Formation, Victorio Mountains.

medium crystalline limestone, but in general the aphanitic texture has been preserved. One hundred and nine feet of strata were assigned to the Big Hatchet Formation, but without a distinct basal contact only a partial section must be present.

The contact between the Big Hatchet Formation and the overlying Cooks Formation is not lithologically sharp nor distinct, but a lack of chert nodules and the appearance of endoceroids are strong evidence for the beginning of Flower's (1964) 1st Endoceroid zone. Silty, light brown calcarenitic limestone comprises the formation, with a conspicuous absence of chert. Pods and lenses similar to those of chert in the Big Hatchet Formation are present in relief, but closer examination reveals them to be "pseudocherty" concentrations of calcareous silt and sand. Silt is also prevalent in wispy, wavy intercalations which weather in strong relief.

Subhedral quartz continues to appear in insoluble residues, along with minor amounts of finely disseminated muscovite flakes. Both of these elements suggest authigenic growth which may have followed closely with the diagenetic recrystallization of the original limestone. The first appearance of long, slender endoceroid siphuncles (including Proendoceras) occurs in the Cooks formation, but along with gastropods these fossils are not abundant. Burrow casts weathering in strong relief on bedding planes complete the faunal evidence found in the Cooks Formation.

The Victorio Mountains are the type locality of the Victorio Hills Formation, where 161-1/2 feet are exposed above the Cooks Formation. The contact between these formations is not sharp and appears

gradational. Silty, gray-weathering calcilutitic and locally calcarenitic limestone is the dominant lithology. These limestones also contain the first appearance of piloceroids in the El Paso Group. Gastropod, brachiopod, and cephalopod hash is scattered throughout the Victorio Hills Formation, increasing in content upsection but usually too small for identification. However, some silicified cephalopod siphuncles are of the aspect Bisonoceras, Stenopiloceras, and Clitendoceras, and brachiopod fragments belonging to Diaphelasma and Finkelnburgia have been recovered. In addition, small (1/4 inch) spheres found in unit 27 appear to be Girvanella, although thin sections reveal a general lack of internal structure.

Subhedral to euhedral quartz is scattered throughout the formation, while small flakes of muscovite become abundant near the top. Similarly, dolomoldic chert is sparse near the base, and then increases substantially in the upper units.

The Jose Formation, typically called the Oolite zone, crops out near the top of the East Hills. Very dark gray, fetid, calcarenitic limestone contains abundant oolites intermixed with intraclasts and a myriad of fossil fragments. Brachiopods, gastropods, and trilobites (of the aspect Aulacoparia) have been recognized. Although only 26 1/2 feet are present, the extreme lithologic contrast between the Jose Formation and adjacent beds make it a very conspicuous formation and an excellent marker horizon for regional correlation. Post-depositional recrystallization has destroyed original structures, but preferential silification of oolites has greatly enhanced their appearance on exposed surfaces.

The Mud Springs Mountain Formation contains the youngest El Paso rocks exposed in the Victorio Mountains. Unfortunately, erosion is responsible for removing all but 12 1/2 feet of the formation. This is the Bridgeites reef described by Flower (1964), accurately named for the large flat gastropod Bridgeites which is abundant throughout the formation. A smaller, higher spired gastropod found in association is identified as Bridgeina, and is often silicified, weathering in relief (Fig. 8). Other fossils are abundant but much too small for extraction and identification.

Dark gray calcilutitic limestone constitutes the formation, and although it is a cliff-forming, stromatolitic sequence elsewhere in New Mexico, the Mud Springs Mountain Formation exhibits neither of these features in the Victorio Mountains.

Montoya Group

The termination of the El Paso Group at the Mud Springs Mountain Formation indicates that more than 500 feet of younger El Paso beds are absent because of erosion, faulting, and/or nondeposition. Limited outcrops of El Paso Group rocks exist near the base of Mine Hill below the Montoya, but extreme faulting and brecciation do not permit accurate correlation of these beds.

The Montoya Group rocks exposed on Mine Hill are offset by faulting and highly brecciated, making section measurement difficult and often unreliable. However, the formations in the Montoya Group are lithologically distinct, and can be traced out laterally when faulting cuts across bedding planes.

Fig. 8. Silicified molds of Bridgeina gastropods found in unit 38, Mud Springs Mountain Formation, Victorio Mountains.

The Cable Canyon Sandstone and the Upham Formation form a sheer cliff which is visible from atop the East Hills. The lower Cable Canyon rests unconformably on the El Paso limestone, and not only represents a distinct lithologic change, but also a significant change in diagenetic recrystallization and dolomitization. Sixteen feet of dark, brown-weathering dolomitic sandstone are exposed on Mine Hill, containing medium to coarse, poorly sorted, rounded and frosted sand. Bedding has been obscured by dolomitization, along with fossils and any other sedimentary structures.

The Upham Dolomite appears gradational from the Cable Canyon Sandstone, but a minor erosional unconformity may exist locally. The Upham is dark gray and very sandy near the base of the formation, changing upsection into fossiliferous dolomite and finally into cherty dolomite. Fifty-seven feet of calcerenitic dolomite form a shear, resistant ledge, and contain scattered brachiopods and corals with occasional intraclastic zones. As in the Cable Canyon Sandstone, post-depositional recrystallization and dolomitization has erased original textures and structures in the Upham Dolomite. Only a few scattered fossils have escaped alteration.

The Aleman Formation is represented by 223 feet of laminated chert and calcilutitic dolomite. The dolomite weathers light gray to brown in strong recesses compared to the resistant, one to three inch, buff gray to black chert layers (Fig. 9). The amount of chert increases substantially upsection, along with the tendency to be more irregular and nodular. Locally, however, silicification related to faulting accounts for some of the chert and also affects the layering higher in

Fig. 9. Interlayered chert and dolomite typical of the Aleman Formation in the Victorio Mountains.

the section. Faunal remains are sparse, and usually silicified beyond recognition.

The Cutter Formation completes the Montoya group, but post-Ordovician, pre-Silurian erosion has removed over half of the expected thickness. Sixty-four to ninety-three feet of light to medium gray, calcilutitic dolomite is exposed below the Silurian Fusselman Dolomite. The Cutter Formation contains a few chert nodules near the base, with silt scattered throughout the formation.

Snake Hills

The Snake Hills are located 10 miles southwest of Deming, New Mexico, and due south of Red Mountain (Fig. 1). They are a series of low, rolling hills composed of El Paso Group rocks in the east, and Montoya sediments in the west (Fig. 10).

The El Paso Group is 371 feet thick, and includes beds from the Victorio Hills Formation up through the Snake Hills Formation. The section is repeated several times due to a series of north-south imbricate faults which progressively elevate the section from east to west. Consequently, the bedding attitude strikes north-south and dips 10° to the west.

The Montoya Group comprising the western hills is also offset by faulting, but a continuous section from the basal Cable Canyon sandstone up through the Aleman Formation is exposed on the largest hill. Two hundred, four and one-half feet of Montoya Group strata are represented, but an equal thickness is absent due to post-Ordovician erosion.

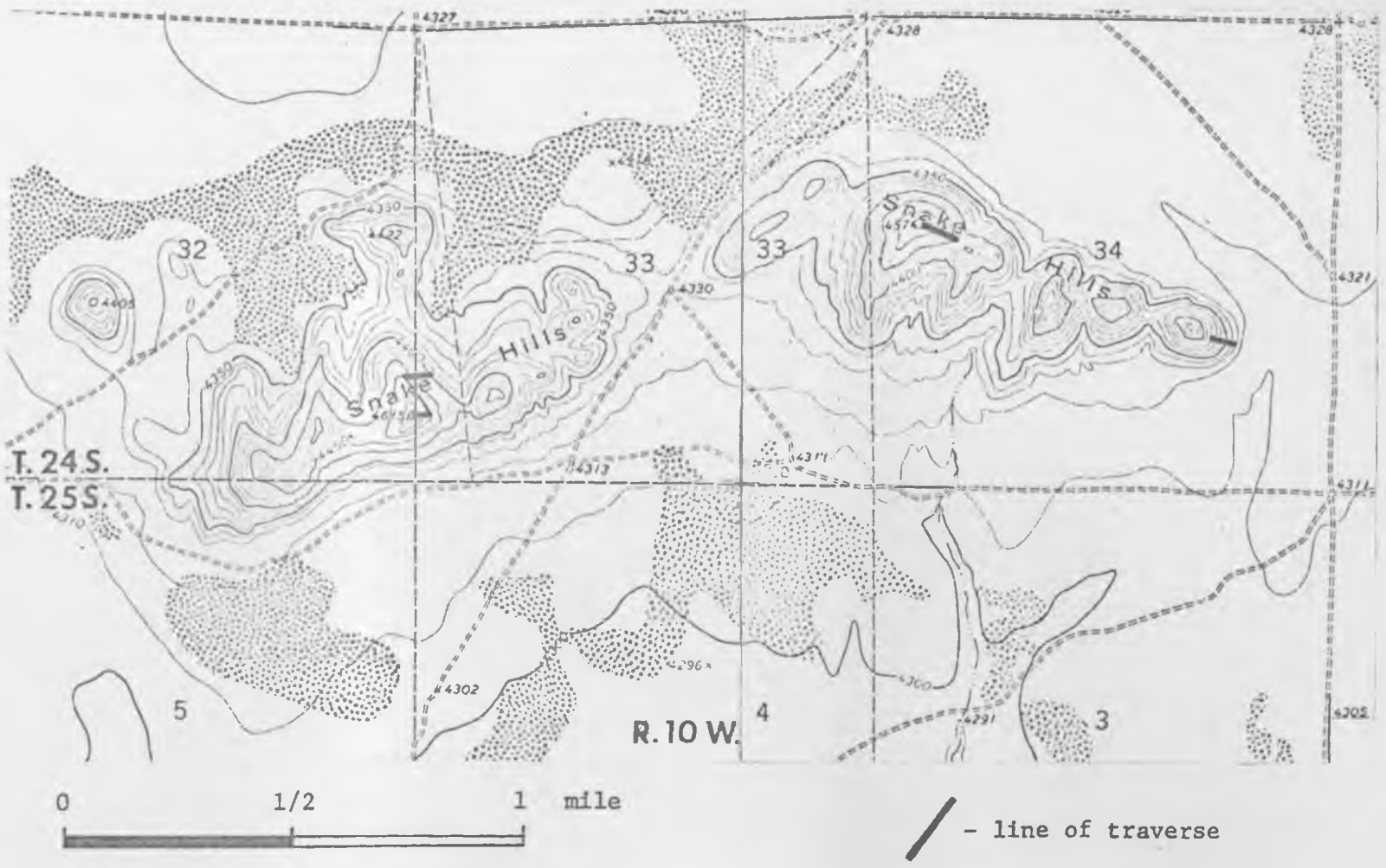


Fig. 10. Location map of measured sections in the Snake Hills, Luna County, New Mexico. (Bowlin Ranch and Red Mountain, New Mexico, 7.5 - minute quadrangles, 1965.)

El Paso Group

The El Paso Group in the Snake Hills consists of basal dolomitic units overlain by thin-bedded, calcilutitic and calcarenitic limestones. The Victorio Hills is the lowest exposed formation and is composed of grayish orange-weathering calcarenitic dolomite. Silt is locally abundant, along with scattered chert nodules and lenses. Pervasive dolomitization has erased any evidence of bedding and internal structures, although preferentially silicified fossils can be found weathering in relief on exposed surfaces. Gastropod and brachiopod fragments are locally abundant, while silicified piloceroid siphuncles, such as Mesopiloceras, and endoceroids of the aspect Bisonoceras and Baschoceras (Flower, 1975) are especially common in the upper units.

Overlying the Victorio Hills Formation with a few feet of interbedding is the Jose Formation, Flower's (1964) Oolite zone. Thirty-three feet of silty, thin-bedded, gray calcarenite form a step-like ledge in contrast to the slope-forming Victorio Hills Formation. Oolites are abundant, often recrystallized and usually associated with biohermal fossil debris. Gastropods, brachiopods, trilobites, and cephalopods are common, but too small and inextractable for identification. In the lower units, 1/4 inch aphanitic spheres weather out completely from the friable, coarse crystalline limestone. Thin sections reveal these to be structureless microcrystalline limestone, possibly algal in origin and related to Girvanella.

A 22 foot transition zone separates the Jose and the Mud Springs Mountain Formations. The zone contains abundant intraclasts in a thin-bedded, gray-weathering calcarenitic limestone. The Mud Springs Mountain

Formation is not well developed in the Snake Hills. Thirty-three and one-half feet of silty, thin-bedded calcilutite comprises the section, forming a series of step-like ledges up to five feet thick. Chert and silt are scattered throughout the formation, and weather in strong relief as hackly, irregular intercalations. Channel fill, intraclasts, and cross-bedding occur locally, while biohermal fossil debris is abundant at all levels. Cephalopod, brachiopod, and gastropod fragments are common, but the large flat gastropod Bridgeites is the only identifiable genus.

The Snake Hills are the type locality for the Snake Hills Formation. One hundred forty-five feet of thin-bedded, calcilutitic limestone are exposed on the highest hill, and represent the youngest formation in the Snake Hills of El Paso Group age. The gray-weathering limestone is locally rich in chert pods and nodules, which may or may not be associated with wispy silt intercalations weathering in relief.

Fossils are abundant throughout the formation, often localized in lenses and biohermal zones. Low and high spired gastropods are common, including Proliospira and Maclurites. Clitendoceras siphuncles are silicified and weathering in relief, as are some sponges of the aspect Archaeosouphia. Brachiopods and trilobites complete the fauna, but many fragments are too small to identify.

A combination of faulting and erosion accounts for the absence of a large part of the El Paso Group in the Snake Hills. Beneath the Cable Canyon Sandstone are limited exposures of limestone, but their position in the stratigraphic section cannot be accurately determined.

Montoya Group

The Montoya Group forms the western cluster of low rolling hills in the Snake Hills (Fig. 10). The basal contact with the El Paso Group is sharp and distinct, but the Cutter Formation and part of the Aleman have been removed by post-Ordovician erosion. A total of 204 1/2 feet of Montoya Group sediments are exposed in the Snake Hills. However, this thickness may represent less than half of the normal thickness developed elsewhere in southwestern New Mexico. Bedding attitudes are similar to those found in the El Paso Group, while throughgoing faults are less pervasive.

The Cable Canyon Sandstone is well developed at the base of the Montoya Group. Twenty-six feet of dolomitic sandstone and sandy dolomite form a shear, resistant cliff with the overlying Upham Dolomite. The Cable Canyon Formation contains poorly sorted, rounded to subrounded, frosted sand grains in a brown-weathering calcarenitic dolomite matrix. Dolomitization has erased any evidence of bedding or other sedimentary structures, and only a few scattered fossil fragments have escaped alteration.

An erosional unconformity apparently separates the Upham Dolomite from the Cable Canyon Sandstone. The base of the Upham contains abundant poorly sorted, rounded sand grains, but higher in the formation terrigenous material is conspicuously absent. Small, recrystallized fossil fragments are visible on the brown-weathering, massive calcarenitic dolomite; however, they defy extraction and identification. Very minor chert breccia is scattered near the top of the Upham Formation, but this

is probably an ingress of silicification which occurred in the Aleman Formation.

Erosion has stripped away part of the Aleman Formation, leaving a one hundred and twenty-four foot section which is well developed and a resistant cliff-former. Brown-weathering calcilutitic dolomite is interbedded with two to three inch red chert layers. The total chert content is relatively high throughout the formation, and near the top of the section dolomite is almost completely absent. The chert weathers in strong relief in continuous layers and bands low in the formation, and then becomes nodular and irregular upsection. Faunal remains are absent or obliterated by dolomitization, and original bedding is only preserved where chert and dolomite interlayering is laterally contiguous.

Big Florida Mountains

The Big Florida Mountains lie southeast of Deming, New Mexico, and trend north-south for almost 10 miles (Fig. 1). Considerable faulting and uplift have brought Precambrian rocks in contact with Lower and Upper Paleozoic sediments. At Capitol Dome, located on the northwest flank of the range, Lower Paleozoic strata rest directly on Precambrian granite, representing a near-continuous sequence of deposition through the Ordovician (Fig. 11).

The El Paso and Montoya Groups are well developed at Capitol Dome, although post-Montoya erosion has removed all of the Cutter Formation and some of the Aleman. Bedding varies locally due to faulting and folding, but a N. 40° E., 30° SE. attitude is the average position of the beds.

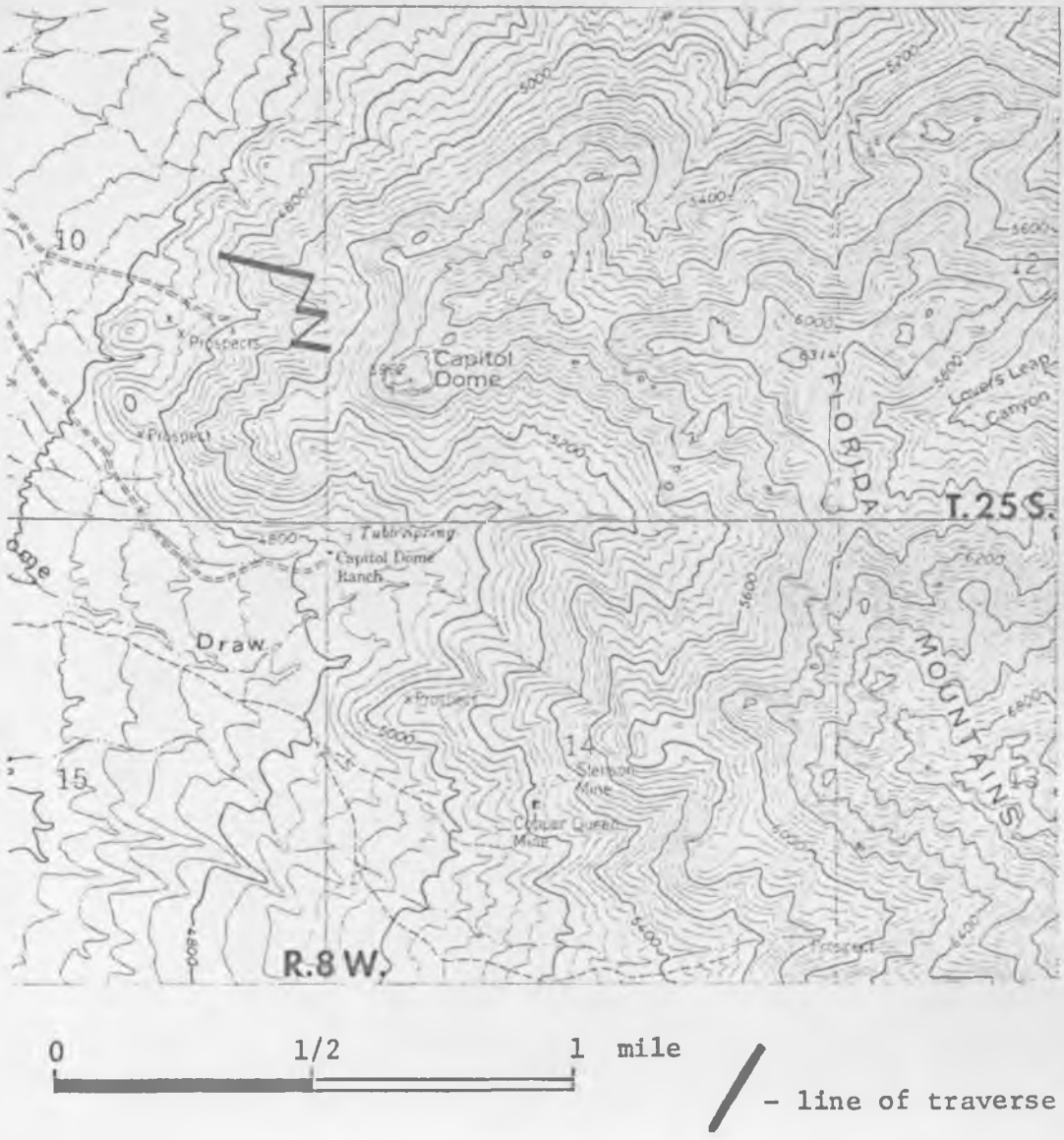


Fig. 11. Location map of measured sections at Capitol Dome in the Big Florida Mountains, Luna County, New Mexico.

(Capitol Dome, New Mexico, 7.5 - minute quadrangle, 1965.)

El Paso Group

The El Paso Group at Capitol Dome is one of the most continuous and best exposed sections in southwestern New Mexico. A total of 965 feet of El Paso Group rocks were measured, including strata from the lowermost Sierrite Formation up through the Scenic Drive Formation at the top of the section. Numerous faults transect the sequence, but with the exception of only one major fault, offset rarely exceeds five feet.

The basal Sierrite Formation is a continuous sequence of silty to sandy, gray-brown-weathering calcarenitic dolomite, with a few feet of transitional sandy dolomite carried over from the Bliss Sandstone. The Sierrite is a resistant, cliff-forming section with dolomitization so advanced that original textures and structures have been destroyed. Near the top of the formation, however, dark, spherical structures 1/4 inch to 1/2 inch in diameter occur in abundance (Fig. 12). These are probably algal in origin, belonging to Girvanella or a similar genus. Etched surface studies revealed very little in the way of internal structures, but despite dolomitization the outline and concentric appearance of these structures has been preserved.

Whether the Big Hatchet Formation is present at Capitol Dome is difficult to determine. Dolomitization is too advanced in the lower 175 feet of the El Paso Group to distinguish between Sierrite and Big Hatchet strata. Euhedral quartz does exist higher in the dolomite sequence, but this may be overgrown on the sand that occurs in the lower units, and is in no way unique to either the Sierrite or the Big Hatchet Formation. The Big Hatchet Formation may indeed be poorly developed or absent altogether, but available lithologic data does not confirm either possibility.

Fig. 12. Girvanella algal structures in unit 4 of the Sierrite Formation at Capitol Dome, Big Florida Mountains.

The first occurrence of limestone in the El Paso Group is in the Cooks Formation. Sixty feet of brownish gray-weathering calcareous dolomite and dolomitic limestone contain sparse endoceroid siphuncles for which the Cooks Formation is diagnostic. Silt is locally abundant, along with minor amounts of subhedral quartz grains. Diagenetic recrystallization of the original limestone was pervasive, followed closely by partial dolomitization, and preferential silicification of endoceroid siphuncles.

In contrast to the brownish gray-weathering Cooks Formation, the Victorio Hills Formation is a bluish gray-weathering, silty, calcilutitic limestone and dolomitic limestone. Dolomitization decreases upwards until only preferential dolomitization of oolites and fossil fragments occurs near the top of the formation.

A diverse faunal assemblage occurs midway through the section, including gastropods, brachopods, trilobites, endoceroids, such as Capricoceras, and stromatolitic algal heads. Piloceroids appear for the first time in the El Paso, including Mesopiloceras, but they are usually too small or unrecoverable for identification. In addition to algal stromatolites, small 1/4 inch to 1/2 inch spheres could represent Girvanella, although preservation is wanting (Fig. 13). Thin sections reveal the spheres to be aphanitic, locally recrystallized, with no apparent internal structure. Oolites are scattered, and exhibit excellent radiate internal structure in thin section. Intraclasts are locally abundant, along with wispy, wavy silty intercalations weathering in strong relief. Subhedral quartz occurs disseminated in the lower units, and seems to pass upwards into rounded and frosted sand grains.

Fig. 13. Girvanella algal spheres in unit 19, Victorio Hills Formation, Big Florida Mountains.

The Jose Formation is anomalously thin in the Florida Mountains, reaching a thickness of only 19 feet at Capitol Dome. Dark gray, fetid, calcilutitic to calcarenitic limestone comprises the formation, with an abundance of oolites and fossil hash (Fig. 14). Consequently, Flower (1964) has named this the Oolite zone; it is an excellent marker horizon for local and regional correlation.

The abundant oolites are usually recrystallized, sometimes silicified, and found in association with intraclastic channel fill and fossil debris. Although fossils are usually too small to identify, some brachiopods, gastropods, trilobites of the aspect Aulacoparia, and cephalopods are locally present. Recrystallization occurs throughout the limestone but is especially prevalent where oolites and fossil hash are concentrated.

Separating the Jose and Mud Springs Mountain Formations is a transition zone of thin-bedded, silty, fossiliferous calcilutite. The zone weathers gray and contains channel fill laden with intraclasts and fossils similar to those found in the Jose Formation.

The Mud Springs Mountain Formation is not well developed at Capitol Dome. Thin-bedded, light gray-weathering calcilutitic to calcarenitic limestone forms a 20 1/2 foot thick step-like ledge. Hackly, cherty intercalations weather in strong relief, along with occasional silicified cephalopod siphuncles. Brachiopods, gastropods, and echinoderm fragments are scattered throughout the formation, but the large flat gastropod Bridgeites is the only extractable and identifiable fossil in abundance. This gastropod, along with large digitate algal

Fig. 14. The contact of the Jose Formation (J) and the Victorio Hills Formation (V) at Capitol Dome in the Big Florida Mountains.

stromatolites, prompted Flower (1964) to name this formation his Bridgeites reef (Fig. 15).

The Snake Hills Formation rests comformably on the Mud Springs Mountain Formation. This section of the El Paso Group consists of a repetitive sequence of fossiliferous, intraclastic calcilutite, alternating with thin units of silty fossiliferous calcilutitic limestone. The silty units weather grayish orange and usually form small, single ledges. The thicker blue gray-weathering limestone forms a series of step-like ledges.

Abundant flat and high spired gastropods, trilobites, and brachiopods occur throughout the formation, along with silicified piloceroid and endoceroid siphuncles. Silt weathers in relief as wispy, wavy intercalations, and sand and silicified fossil fragments can be found locally near the top of the formation.

At Capitol Dome, the character of the El Paso Group above the Snake Hills Formation does not completely relate to the same succession of strata known elsewhere in New Mexico and west Texas as the McKelligon Canyon Formation. Usually at the base of the formation is the Pistol Range Member, as much as five feet of sandstone overlain by largely stromatolitic limestone. At Capitol Dome, a slightly sandy two foot unit could represent the base of the Pistol Range Member, but the abundant stromatolite zones are not common higher in the section. At best, the base of the McKelligon Canyon Formation is probably marked by this sandy unit, and lithofacies variations account for the lack of algal structures higher in the section.

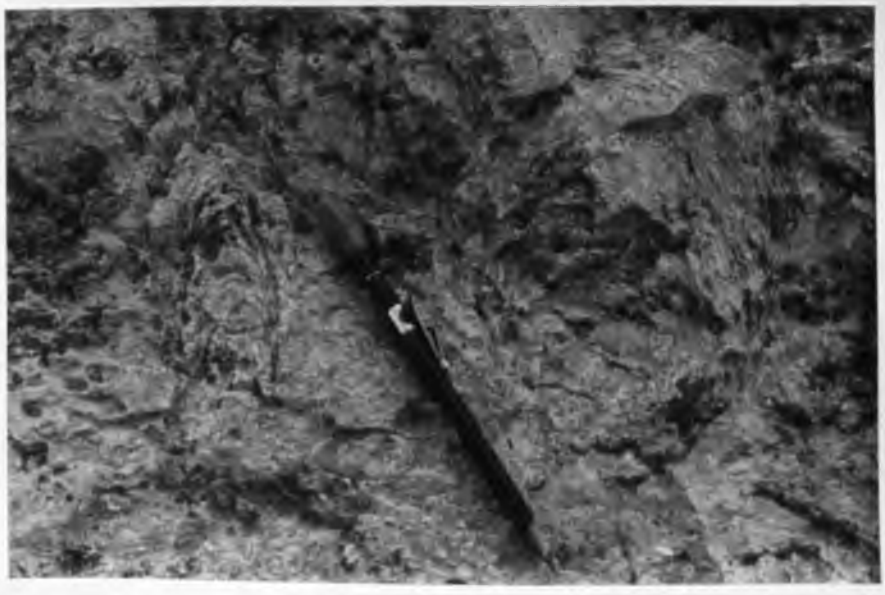


Fig. 15. Digitate algal structures developed in unit 27, Mud Springs Mountain Formation, Big Florida Mountains.

Approximately 262 1/2 feet of strata belonging to the McKelligon Canyon Formation are exposed at Capitol Dome. The entire section consists of thin-bedded bluish gray-weathering calcilutite which is locally recrystallized and rarely dolomitized. The McKelligon Canyon Formation is classified by Flower (1964) as the second and third Piloceroid zones, characterized by an abundance of silicified piloceroid siphuncles. Gastropods, brachiopods, including Diparelasma, and some trilobites are present, along with Archaeosouphia sponges which are locally silicified (Fig. 16). Intraclastic pods and lenses are scattered throughout the section, while chert nodules are common in the upper units.

The appearance of dolomite in the middle of the formation indicates that, in addition to post-depositional recrystallization, dolomitization occurred locally and does not appear to have preferentially replaced any particular structure or fauna. The calcilutitic texture of the limestone has been recrystallized to calcarenite, especially in layers rich with fossil debris or intraclasts.

The contact between the McKelligon Canyon Formation and the overlying Scenic Drive Formation is vague and difficult to ascertain. At other localities in New Mexico, the Scenic Drive Formation is marked by basal sandy dolomites that grade upward into dolomite and finally into limestone. From the base of the McKelligon Canyon Formation, however, insoluble residues are limited to dolomoldic chert and aggregated silt, with very minor sand occurring well into the Scenic Drive Formation.

Nevertheless, lithologic evidence suggests that the upper 164 feet of El Paso Group rocks at Capitol Dome belong to the Scenic Drive Formation. This is still only a partial section, because post-El Paso,

Fig. 16. Cross-section of an Archaeosouphia sponge exposed in unit 67, McKelligon Canyon Formation, Big Florida Mountains.

pre-Montoya erosion and a major fault near the base of the formation have deleted at least part of the section (Fig. 17).

Thin-bedded, gray-weathering calcilutitic to calcarenitic limestone constitutes the section. Silt and chert increase in content upsection and weather in strong relief as irregular, hackly intercalations. Just above the major fault are dark, largely intraclastic limestone units which contain clasts up to six inches long. Fossils are scattered and nowhere abundant, including gastropods, brachiopods, trilobites, such as Pseudocybele, and cephalopod fragments.

The Florida Mountains Formation was not recognized at Capitol Dome, but on the southeast flank of the Florida Mountains as much as 30 feet have been reported. Flower (1975) believes two to three feet of friable, nonresistant limestone exposed beneath the Cable Canyon Sandstone could belong to the Florida Mountains Formation, but insufficient exposure does not allow for accurate delineation at this time.

Montoya Group

Post-El Paso erosion left an irregular surface upon which the basal Montoya Group sediments were deposited. For this reason the thickness of the Cable Canyon Sandstone and the Upham Dolomite varies laterally. The most complete section of Montoya strata crops out directly south of the measured section of the El Paso Group (Figs. 11 and 18).

The Cable Canyon Sandstone is not as well developed at Capitol Dome as it is elsewhere in New Mexico. The formation consists of poorly sorted, coarse-grained sandy dolomite, and forms a shear cliff with the overlying Upham Dolomite. Dolomitization has erased any evidence of

Fig. 17. The contact between the El Paso (E) and Montoya (M) Groups at Capitol Dome in the Big Florida Mountains.

A major fault cuts through the Scenic Drive Formation near the top of the El Paso Group.

Fig. 18. An excellent exposure of El Paso Limestone (E) overlain by the Cable Canyon Sandstone (C), the Upham Dolomite (U), and the Aleman Formation (A) at Capitol Dome in the Big Florida Mountains.

original structures and faunal remains, leaving only a 33 1/2 foot cliff of massive gray sandy dolomite.

Forty-one feet of Upham Dolomite rest on the Cable Canyon Sandstone. The contact appears gradational, but a minor unconformity could exist between the formations. Dark gray, massive, calcarenitic dolomite typifies the Upham Formation, with bedding irregular or totally obscured by dolomitization. The Upham Dolomite is very fetid, and contains partially preserved fossil debris, including cephalopods, brachiopods of the aspect Lepidocyclus, and gastropods. Silt and sand are minor constituents, while intraclasts are abundant near the top of the formation.

Unconformably overlying the Upham Dolomite is the Aleman Formation. Cherty, interlayered calcarenitic dolomite is the dominant lithology, but in the upper units chert diminishes and limestone dominates the formation. Light gray-weathering cherty calcareous dolomite passes upward into dolomitic limestone with a substantial decrease in chert. Fossils are increasingly abundant near the top of the Aleman, usually silicified and weathering in relief. One-hundred and twelve feet of Aleman strata were measured, but post-Montoya erosion has cut down through the Cutter Formation and no doubt removed a significant amount of the Aleman Formation.

CORRELATION AND INTERPRETATION

The Victorio Mountains, the Snake Hills, and the Big Florida Mountains exhibit stratigraphic sections of El Paso and Montoya Group strata that can be traced laterally and correlated among the three field areas. At each locality only partial sections are exposed, but the available formations are lithologically, paleontologically, and/or stratigraphically distinct, providing adequate data for local and regional correlation. As mentioned previously, erosion and faulting are responsible for the absence of individual units and complete formations. In addition, less obvious diastemic breaks may exist in the sequence, but are too subtle to recognize.

Stratigraphic correlation is based on a compilation of all available information gathered in the field and in the laboratory to ensure that the most logical and viable associations can be drawn among the three field areas. In some cases, interpolation is required when data is limited or boundaries between formations are poorly developed. Fig. 3 illustrates the correlation of Ordovician strata in Luna County, New Mexico.

The El Paso Group exposed at Capitol Dome in the Big Florida Mountains is by far the thickest section found in the three field areas. Continuous deposition beginning with the Bliss Sandstone on the Precambrian granites is carried up through most of the El Paso Group.

The oldest El Paso Group rocks exposed at Capitol Dome belong to the Sierrite Formation. The basal Sierrite exhibits lithologies and

insoluble residues similar to those found in the underlying Bliss Formation. This is anticipated since the contact between the two formations is gradational for several feet. Interbedded sandy dolomite and dolomitic sandstone grade upward into slightly silty and sandy dolomite. Pervasive dolomitization complicates interpretation of the formation, but this is the case wherever the Sierrite is exposed. Subangular sand is replaced by euhedral quartz higher in the section, indicating that silicification was part of the diagenetic history, but limited to upper units. The presence of sand, along with Girvanella which remarkably escaped complete alteration, suggests the Lower Gasconade was characterized by nearshore, shallow marine environments (Fig. 12). Girvanella probably flourished in subtidal to intertidal channels where the influx of clastics was minimal. If the Big Hatchet Formation is not represented at Capitol Dome, the Sierrite Formation attains a thickness of 175 feet. This is anomalously thick when compared to 121 feet of the same formation exposed in the Franklin Mountains.

Whether the Big Hatchet Formation is present in the Florida Mountains is extremely problematical. Dolomitization has erased original textures and structures so very little detail of any value remains. If the uppermost dolomite exposed at Capitol Dome does belong to the Big Hatchet Formation, it does not exhibit the characteristics described at the type locality in the Big Hatchet Mountains. Flower (1964) recognized the Big Hatchet Formation to consist of interbedded dolomite and shales, with an abundance of chert higher in the section. Neither shales nor chert are present in the dolomite at Capitol Dome, but their

absence could be attributed to incomplete development of the formation and lithofacies variations.

Besides the type locality, the only other known exposure of the Big Hatchet Formation occurs in the Victorio Mountains. The interbedded shales are conspicuously absent, but chert nodules are abundant in the upper units. Local recrystallization and silicification are the only evidence of diagenesis. Silty calcilutites suggest shallow marine conditions prevailed through the end of the Gasconadian, with the introduction of a limited faunal assemblage.

The beginning of the Cooks Formation is marked by the diminution of dolomitization at Capitol Dome and a termination of chert in the section in the Victorio Mountains. The first appearance of endoceroids in the El Paso Group suggests slightly deeper marine waters accommodated a more prolific fauna. In addition to endoceroids, brachiopods, gastropods, and trilobites flourished in the nearshore marine environment. An active positive source continued to supply silt with minor sand that now exhibits subhedral overgrowths because of silicification. The appearance of limonite pseudomorph after pyrite, and mica (probably muscovite) indicate that quartz overgrowths were not the only authigenic products of diagenesis.

The Cooks Formation is 60 feet thick at Capitol Dome, while the same sequence reaches a thickness of 194 1/2 feet in the Victorio Mountains. Substantial thickening to the west is obvious, but the Cooks Formation in the Victorio Mountains is anomalously thick for southwestern New Mexico, where 80 feet is usually the maximum.

The Victorio Hills Formation is marked by the introduction of piloceroids in the Demingian seas. Brachiopods, gastropods, and sponges thrived in the shallow marine waters, along with algal stromatolites. Very distinct spherical Girvanella occur in the upper units at Capitol Dome and in the Victorio Mountains. Their presence near the base of the Jose Formation (Oolite zone) could indicate the onset of marine regression and/or uplift, creating the tidal flat environments which existed briefly during Middle Demingian time.

Silty limestone comprises the formation in the Victorio Mountains, while both the Snake Hills and Big Florida Mountains exhibit dolomitic beds. At Capitol Dome, dolomitization reaches its highest penetration into the El Paso section, but pervasive dolomitization occurs throughout the Victorio Hills Formation exposed in the Snake Hills. Diagenesis in the Victorio Mountains is limited to recrystallization, local silicification, and the authigenic development of abundant muscovite (Fig. 19). Thickening from east to west was maintained during deposition of the Victorio Hills Formation, with 90 feet of strata exposed at Capitol Dome, 140 feet in the Snake Hills, and 161 1/2 feet in the Victorio Mountains.

The Jose Formation, or more appropriately, the Oolite zone, is the most conspicuous formation in the El Paso Group, and an excellent marker horizon for stratigraphic correlation. Dark, often fetid limestone is the dominant lithology at all three field areas. Oolites are abundant and associated with intraclasts and fossil debris, especially asaphid trilobites. Sand and subhedral quartz are obvious constituents, but preferentially silicified oolites are unique to the Jose Formation

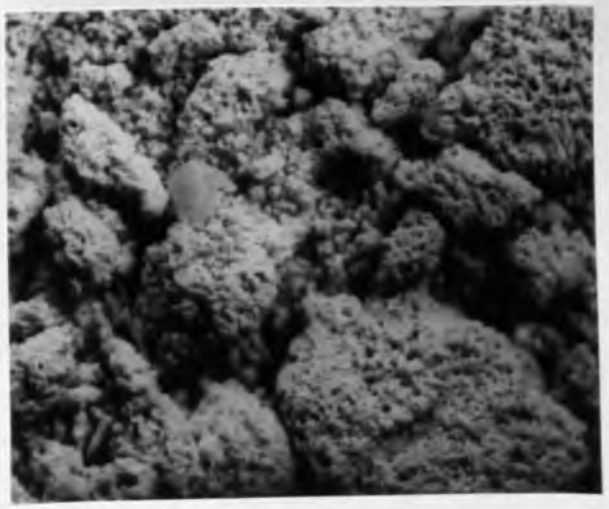


Fig. 19. Skeletal dolomolds in chalky chert from unit 20, Victorio Hills Formation, Big Florida Mountains (x 8).

(Fig. 20). Very shallow tidal flat environments apparently shifted with restrictive embayments to produce oolite channel fill deposits and muddy, fetid limestones.

Thickness of the Jose Formation varies, but a general increase from east to west is implied. Nineteen feet are exposed at Capitol Dome, 33 feet in the Snake Hills (including 16 1/2 feet of interbedded dolomite and oolitic limestone at the base), and 26 1/2 feet in the Victorio Mountains. This thickening to the west is consistent with underlying formations.

Renewed shallow marine conditions promoted the development of the intraclastic limestone that forms the transition zone. Erosion or nondeposition accounts for the absence of this zone in the Victorio Mountains.

Consistent with deepening environments is the development of the Mud Springs Mountain Formation, designated the Bridgeites reef by Flower (1964). Digitate algae covered the sea floor and sent mushroom-like fingers and mounds up near the surface, sometimes resulting in death and truncation of the algae. Faunal life is abundant but dominated by a profusion of large flat Bridgeites gastropods.

Post-depositional silicification produced irregular chert intercalations which may be the preferential silicification of algal mats (Fig. 21). In the Victorio Mountains, gastropods have also been replaced by chert. The Bridgeites reef increases westerly in thickness from 20 1/2 feet in the Florida Mountains, to 33 1/2 feet in the Snake Hills. Although only 12 1/2 feet are present in the Victorio Mountains, erosion has terminated the El Paso Group in the Mud Springs Mountain Formation,

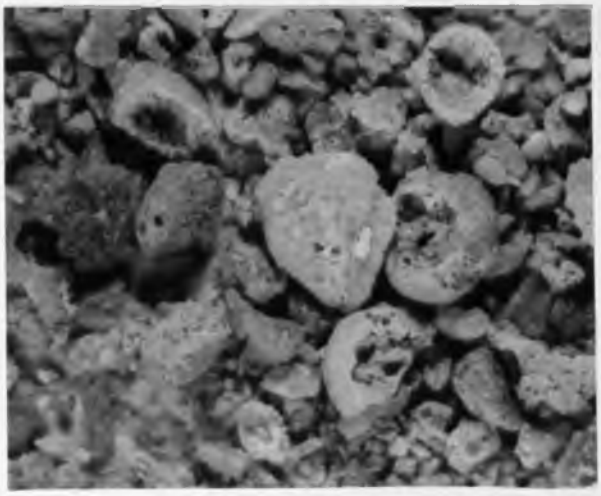


Fig. 20. Typical silicified hollow oolites from unit 14 of the Jose Formation, located in the Snake Hills (x 8).

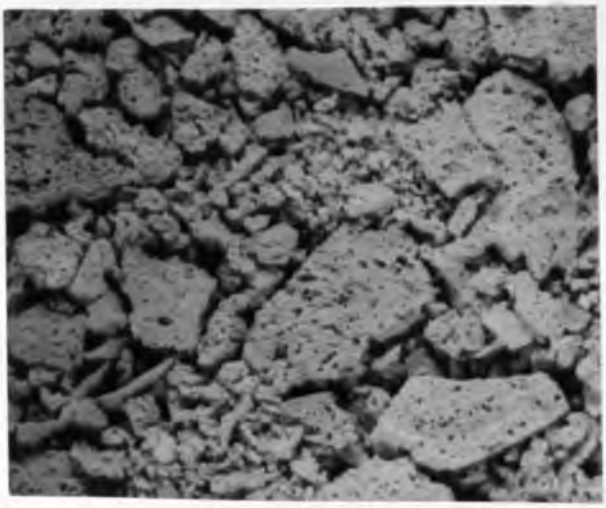


Fig. 21. Scattered dolomolds in chalky chert recovered from unit 18, Mud Springs Mountain Formation, Snake Hills (x 8).

and as much as 40 to 50 feet could have originally existed at this locality.

Late Demingian seas remained shallow and promoted the deposition of sediments assigned to the Snake Hills Formation. Thin-bedded, silty intraclastic calcilutite has been only locally recrystallized. Chert has preferentially replaced sponge, gastropod, and cephalopod fragments, in addition to forming chert nodules and lenses throughout the formation in the Snake Hills (Fig. 22). At Capitol Dome, 138 feet of strata belonging to the Snake Hills Formation are exposed. This increases to 145 feet in the Snake Hills, although erosion has deleted part of the formation at the type locality.

Above the Snake Hills Formation, sediments belonging to the El Paso Group are exposed only at Capitol Dome. The base of the McKelligon Canyon Formation is usually represented by the sandy Pistol Range Member, but two feet of slightly sandy limestone are the only remnant of this member at Capitol Dome. Two hundred sixty-two and one-half feet of silty calcilutite are consistent with the shallow marine deposits of the underlying Snake Hills Formation. Stromatolites are less common than they are in eastern New Mexico, but the fossiliferous, intraclastic lithology is preserved.

Post-depositional diagenesis involves local recrystallization and dolomitization of the middle units. Preferential silicification of sponges and cephalopod siphuncles occurs, along with chert nodules found high in the section (Fig. 23).

The contact between the McKelligon Canyon and Scenic Drive Formations is vague, due to poor development of both sections. The Scenic

Fig. 22. Silicified gastropod fragments found in unit 29 of the Snake Hills Formation at the type locality (x 8).

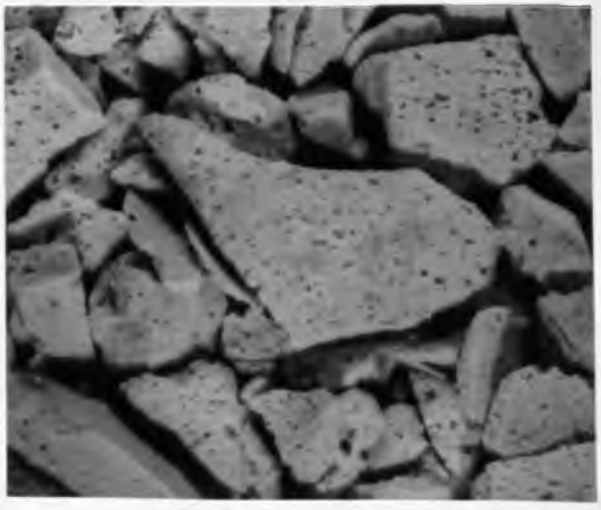


Fig. 23. Chalky chert with scattered dolomolds from unit 65, McKelligon Canyon Formation, Big Florida Mountains (x 8).

Drive Formation consists of silty, cherty calcilutite which corresponds to the Nameless Canyon Member described near El Paso. However, the Black Band dolomite typically developed at the base of the formation is absent. A major fault low in the section could be responsible for deleting this member.

Intraclasts and abundant fossil debris suggest active shallow marine conditions were maintained through the Cassinian, with a strong influx of clastic material from an eroding land mass. Silicification is profound throughout the formation, replacing fossils and forming abundant hackly chert intercalations and nodules.

The upper 164 feet of El Paso Group strata exposed at Capitol Dome represent the youngest Canadian rocks at this locality. Post-Canadian erosion produced an irregular surface upon which the basal Montoya sediments were deposited.

The onset of Montoya deposition is marked by a significant environmental change. The basal Cable Canyon Sandstone represents a shift from deposition in shallow marine waters, to deposition and reworking of clastics in a shoreline to very shallow nearshore environment. Poorly sorted, rounded and frosted sand dominates the Cable Canyon Formation in the Victorio Mountains and Snake Hills, while dolomite constitutes a larger part of the section at Capitol Dome (Fig. 24). Dolomitization has obliterated all original textures and structures in the three field areas. Thinning is apparent from east to west, whereby 33 1/2 feet exposed at Capitol Dome thin to 26 feet in the Snake Hills, and finally to 16 feet in the Victorio's.

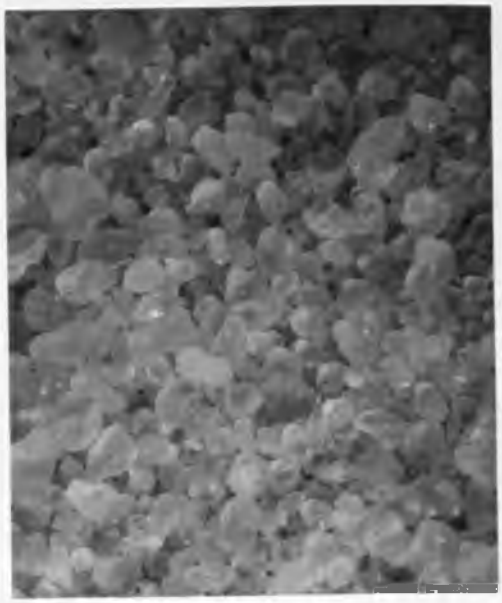


Fig. 24. Clean, rounded and frosted sand grains from the Cable Canyon Sandstone at Capitol Dome in the Big Florida Mountains (x 8).

The Upham Dolomite is characterized by a sudden lack of sand and an increase in preservation of internal structures. The contact between the Upham Dolomite and the Cable Canyon Sandstone is usually gradational, but evidence of a minor disconformity exists locally.

Slight deepening of the Late Trentonian seas produced thick-bedded accumulations of dark, fetid limestone in restricted embayments. Dolomitization has replaced and recrystallized the original sediments, accompanied by minor silicification, especially in the Victorio Mountains. In contrast to the westward thinning Cable Canyon Formation, the Upham increases from 41 feet at Capitol Dome to 54 1/2 feet in the Snake Hills, and finally to 57 feet in the Victorio Mountains. This change may result from a sudden shift in subsidence, or a greater depth of erosion in the west prior to deposition of the Upham Formation.

The Aleman Formation is very distinct lithologically and forms a sharp basal contact with the Upham Dolomite. Interbedded chert and dolomite layers are very well-developed low in the formation (Fig. 9). This excellent alternation of dolomite and chert could suggest the influx of silica or silica-bearing solutions was penecontemporaneous with deposition of the original limestone. Biogenic contributions are the most probable source of silica which could accumulate in sufficient amounts to form layers of siliceous gel near the depositional interface and consolidate under normal compaction. However, the chert layers become more erratic and nodular upsection, hence post-depositional silicification could account for the abundance of chert throughout the Aleman (Fig. 25). Faunal remains are sparse, but at Capitol Dome brachiopods are silicified and weather in strong relief.

Fig. 25. Translucent chert typical of the Aleman Formation in the Montoya Group located in the Snake Hills (x 8).

Post-Montoya erosion has cut down through the Cutter Formation and into the Aleman at Capitol Dome and in the Snake Hills, leaving only 112 feet and 124 feet, respectively. In the Victorio Mountains, however, erosion has only removed part of the Cutter Formation, and a complete Aleman section of 223 feet represents continuous deposition during the Early Richmond.

The Cutter Formation is comprised of the youngest Ordovician sediments found in southwestern New Mexico. Post-Ordovician, pre-Silurian erosion has removed much of the formation from the Victorio Mountains, but up to 93 feet are still present. As in the Aleman Formation, dolomitization has completely erased internal structures not preserved by silicification. No doubt nearshore, shallow marine conditions prevailed in southwestern New Mexico through the end of the Ordovician, followed by regional uplift and truncation prior to the onlap of Silurian seas.

SUMMARY

The Lower Paleozoic stratigraphy in the three field areas is consistent with similar sections exposed in southwestern New Mexico and west Texas. Although lithofacies variations exist locally in the El Paso Group, distinct lithologies and faunas in key marker units augment correlation and increase the extent of the environments in effect during the Ordovician.

The basal contact of El Paso age rocks with the Bliss Formation is usually gradational, but can easily be recognized in exposed sections or in drill cores by the sudden change in sand content. Within the El Paso Group, boundaries between formations become less obvious and are not always laterally consistent. However, the Jose Formation, or the Oolite zone, is a very conspicuous horizon located midway through the section, making an excellent stratigraphic break between upper and lower El Paso Group strata (Fig. 14).

The erosional unconformity between the El Paso and Montoya Groups is always apparent. Topographically, the El Paso Group is a nonresistant slope-former, while the Montoya sediments are more resistant and form a shear cliff near the base. The formations comprising the Montoya Group are lithologically unique, and can usually be recognized immediately in the field. The upper contact with the Silurian Fusselman Dolomite is not always clear, but the Fusselman can be separated from the underlying Cutter Formation by lithologic differences.

Correlation among the three field areas has been based on a compilation of all available information, with emphasis placed on lithologies and associated faunas. The application of insoluble residues, although supplemental in many cases, can be important. For example, in the Jose Formation, silicified oolites which may otherwise be overlooked are invaluable for recognizing this horizon in well cuttings and drill cores (Fig. 20). The Pistol Range Member of the McKelligon Canyon Formation is an example where a poorly developed unit could be detected with insoluble residues, but may remain vague in outcrop. Other residues, such as dolomoldic chert and quartz grains with overgrowths, provide insight as to the diagenetic history of the sediments which would not be apparent in etched surfaces and even in thin sections (Figs. 19, 21, and 23).

The accumulation of Lower Paleozoic sediments in the Victorio Mountains, the Snake Hills, and the Big Florida Mountains, is consistent with shallow marine deposition stemming from the unstable Sonoran shelf to the southwest. Shallow nearshore marine conditions prevailed throughout southwestern New Mexico, with local emergence and a low positive source supplying clastics to the subsiding basin. Thickening of sediments from east to west is evident in the entire Ordovician section, although local reversals indicate variations in subsidence. Diagenetic recrystallization, dolomitization, and silicification occurred throughout the section, commonly restricted to particular units or formations. Faulting and erosion has deleted much of the original sequence, especially in the Snake Hills and the Victorio Mountains. However, in excess of

1,000 feet of El Paso Group strata and over 500 feet of Montoya sediments probably accumulated before the close of the Ordovician.

APPENDIX A

TREATMENT OF INSOLUBLE RESIDUES

The classification of insoluble residues used in this study was modified from systems proposed by Ireland (1947) and Grohskopf and McCracken (1949). Much of the basic terminology has been utilized to maintain uniformity and minimize contradiction and confusion. New terms and reorganized flow charts have been introduced to accomodate the types and amounts of insoluble residues recovered from the Ordovician rocks in the three field areas (Figs. A1 and A2).

Definitions of Insoluble Residues

Abundant dolomolds or oomolds: See "dolomoldic."

Aggregated: Loosely packed and consolidated crystals or grains.

Angular: Grains exhibiting little or no evidence of wear; edges and corners sharp.

Anhedral: No crystal form developed.

Banded: Chert containing bands of different colors.

Chalky: Uneven or rough fracture; commonly dull or earthy; soft to hard; may be finely porous; resembles chalk or tripolite. (Formerly referred to as "dead" or "cotton chert.")

Chert: Cryptocrystalline varieties of quartz, regardless of color; composed mainly of petrographically microscopic fibers of chalcedony and/or microcrystalline quartz particles.

Coarse: Particles or grains between .50 and 2.0 millimeters in size. Refers only to complete grains or crystals whose size is not controlled by crushing or similar reduction processes (Folk, 1968).

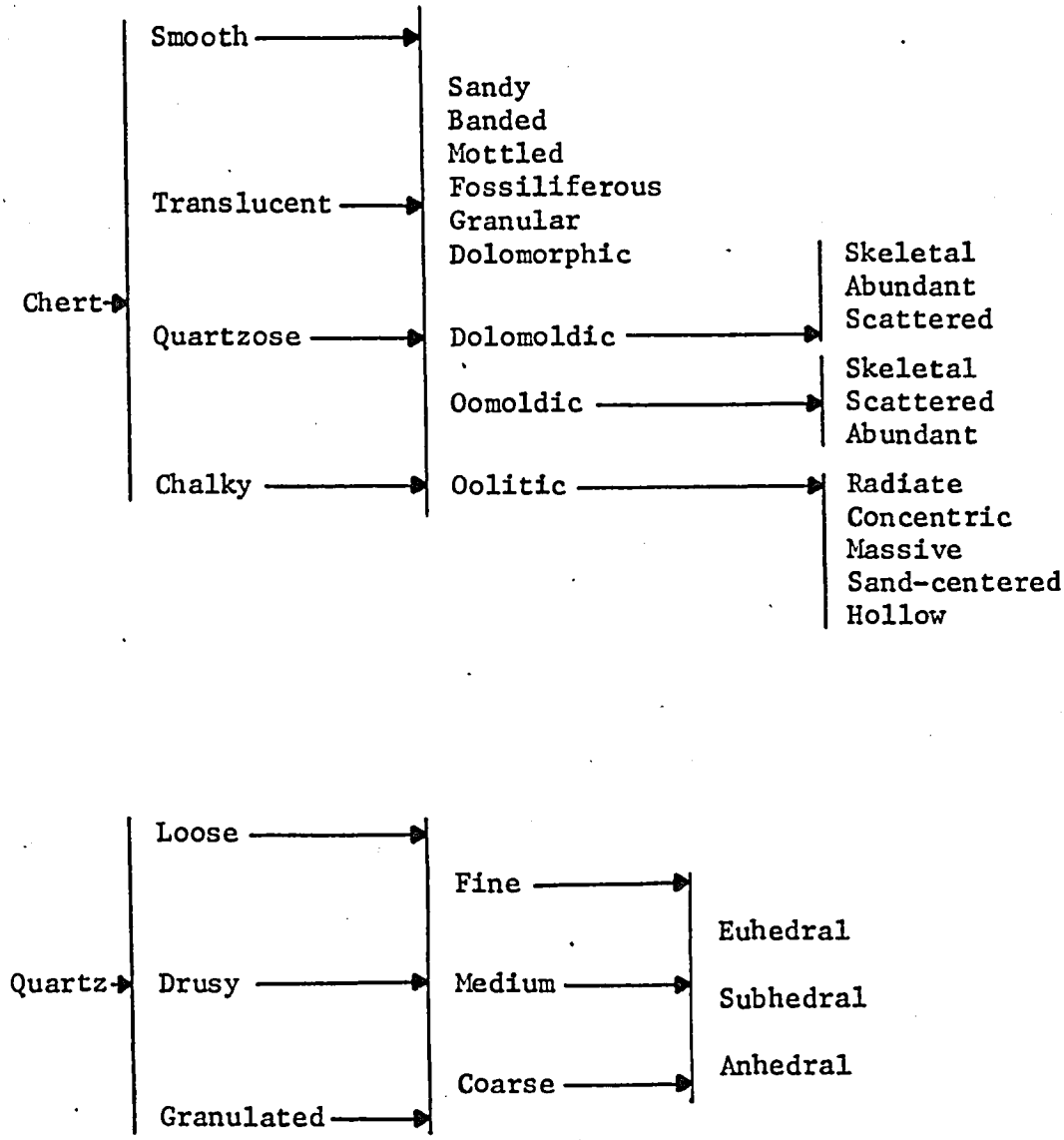


Fig. A1. Flowchart for analysis of nonclastic insoluble residues.

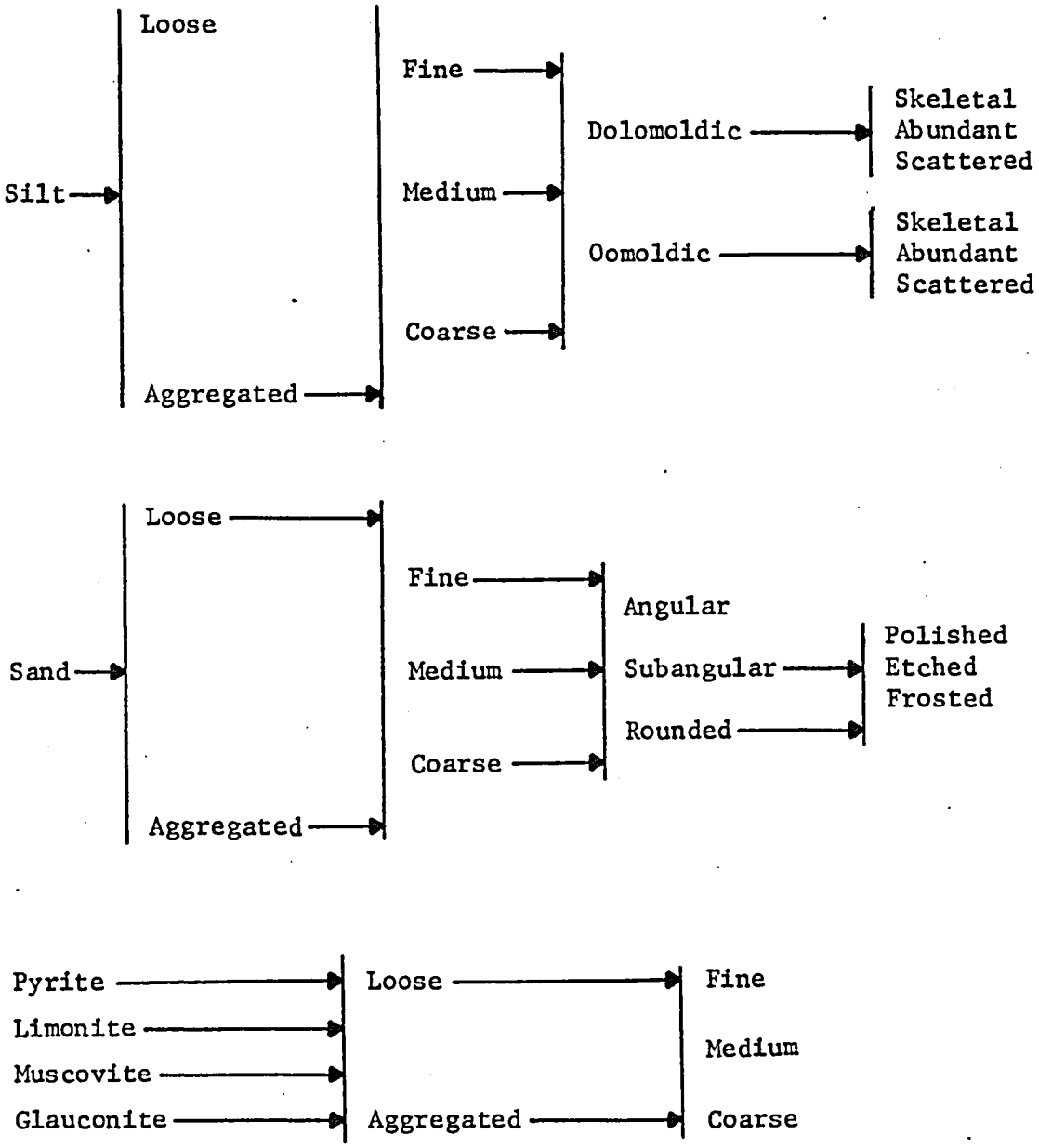


Fig. A2. Flowchart for analysis of clastic and accessory insoluble residues.

Concentric: See "oolitic."

Dolomold: Rhombohedral cavities in an insoluble residue formed by the solution of euhedral dolomite or calcite crystals.

Dolomoldic: Containing dolomolds.

Skeletal: Residues with rhombohedral openings in which the constituent material comprises less than 25 percent of the volume of the fragment.

Abundant: Residues with rhombohedral openings with the constituent material comprising from 25 to 75 percent of the volume of the fragment.

Scattered: Residues having rhombohedral openings in which the constituent material comprises more than 75 percent of the volume of the fragment.

Dolomorphic: Used for describing residues where there has been replacement of dolomite or calcite by an insoluble mineral which assumes the crystal form of the soluble mineral.

Drusy: Clusters or aggregates of crystals, generally incrustations.

Etched: Rough pits or lines on sand grains, often related to crystal structure; usually produced by solutioning.

Euhedral: Doubly terminated crystals; unattached.

Fine: Particles or grains between .0625 and .25 millimeters in size (Folk, 1968).

Fossiliferous: Term describing residues where an insoluble mineral has replaced fossil fragments originally composed of calcite or dolomite.

Frosted: Lusterless, mat surface imposed on sand grains by innumerable contacts with other grains, or as a result of chemical etching.

Glauconite: A light green to dark green mineral found in marine sediments; essentially a hydrous potassium iron silicate.

Granular: Chert; compact, homogenous; composed of distinguishable uniform-sized grains, granules, or druses; uneven or rough fracture surface; saccharoidal.

Granulated: Grains or granules partly cemented or loosely aggregated; saccharoidal; grades from angular to drusy; fine to coarse.

Hollow: See "oolitic."

Limonite: Brown hydrous iron oxide, usually replacing pyrite.

Loose: Free, unattached particles, grains, or crystals.

Massive: See "oolitic."

Medium: Particles or grains between .25 and .50 millimeters in size (Folk, 1968).

Mottled: Chert containing heterogeneous color differences.

Muscovite: A member of the mica group; potassium aluminum silicate; can develop authigenically in sedimentary rocks.

Oolite: Spheroidal bodies with nucleus or central mass enclosed by one or more surrounding layers of the same or different material.

Oolitic: Composed of or containing abundant oolites.

- Concentric: Peripheral layers around a small, undetermined nucleus.
- Hollow: The cast of an oolite produced by partial or incomplete replacement of the original calcite by an insoluble mineral; usually forms a hollow sphere.
- Massive: Interior of granular, smooth, or chalk-textured material comprising nearly the entire mass of the oolite.
- Radiate: Fibers radiating from small or large nucleus; may have several peripheral layers.
- Sand-centered: Oolite with a nucleus of quartz sand.

Oomold: Spheroidal opening representing the former presence of oolites.

Oomoldic: Containing oomolds.

Pitted: Term applied to sand grains exhibiting small pits or depressions caused by agitated contact with other grains.

Pyrite: Iron sulfide sometimes developed authigenically in sedimentary rocks.

Quartz: Clear, colorless quartz; not detrital.

Quartzose: Vitreous, glassy chert.

Radiate: See "oolitic."

Rounded: Spheroidal or ellipsoidal sand grains, coarse to fine, may be frosted, pitted, or etched.

Sand: Grains of sand-sized quartz, usually clear but may be any color.

Sandy: Sand grains in a chert matrix.

Sand-centered: See "oolitic."

Scattered: See "oolomoldic."

Silt: Grains of silt size quartz, but may be composed entirely or partly of other minerals.

Skeletal: See "colomoldic."

Smooth: Chert with conchoidal to even fracture; opaque, flinty, usually brittle; no distinctive structure, crystallinity, or granularity.

Subangular: Polygonal grains or fragments of sand but with well-rounded edges and corners.

Subhedral: Crystal form partly developed; may be loose, drusy, or granulated.

Translucent: Chert exhibiting some degree of translucency; usually smooth, even fracture.

Plotting Insoluble Residues

The insoluble residue data have been plotted directly on the stratigraphic columns in Fig. 3. Each column is one inch wide and, based upon the total percent of insoluble residue contained in any given unit, this width has been subdivided from the left side of the column to represent that percent of residue with the appropriate symbology. This total percent has been further subdivided according to the total coarse (larger than 4 ϕ) residue and the total fine (smaller than 4 ϕ) residue (Fig. A3). Silt, being the fine residue in every case, is always plotted on the left margin of the column, with the coarse residue plotted to the right of this.

With the percent of coarse and fine residues blocked out on the stratigraphic columns, the symbols for the dominant insoluble residues (sand, silt, quartz, and chert) are plotted in their appropriate space.

This provides an immediate visible representation of the type and amount of residue contained in each unit.

A more precise description of the insoluble residues appears on the left side of each stratigraphic column. Here, the symbols relating to particular types and sizes of residues found in Fig. 3 are listed, along with the total percent of those residues found in each unit. The percent of silt is always listed first, followed by the percents of coarser residues. In Fig. A3 , for example, 53L indicates unit 38 in the Victorio Mountains contains 53 percent loose silt. The unit also contains 42 percent scattered dolomoldic chalky chert, and 5 percent loose, fine-grained euhedral quartz. (In some cases, silt is the only residue present, thus 100L appears adjacent to that unit.)

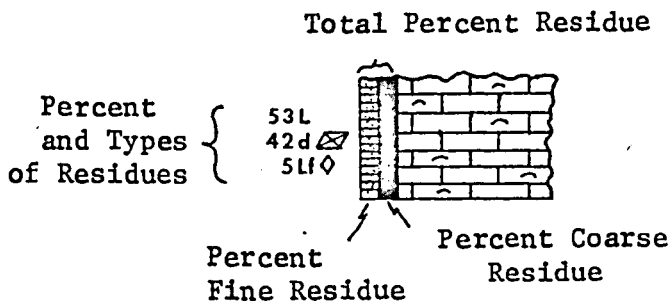


Fig. A3. Unit 38, Victorio Mountains, Luna County, New Mexico.

APPENDIX B

DESCRIPTION OF STRATIGRAPHIC SECTIONS

Victorio Mountains

The El Paso and Montoya Groups were measured on separate hills in the Victorio Mountains. The El Paso section was measured in the East Hills (SW 1/4 NE 1/4 sec. 28, T. 24 S., R. 12 W.), while the Montoya Group was measured on the northeast side of Mine Hill (NW 1/4 NE 1/4 sec. 33, T. 24 S., R. 12 W.) (both are found on the Gage, New Mexico, 7.5 - minute quadrangle, 1963). The base of the El Paso section is marked by a low angle fault, which brings Montoya Group strata in contact with the Big Hatchet Formation of the El Paso Group. The section terminates at the top of the hill in the Mud Springs Mountain Formation, and only scattered outcrops of El Paso limestone appear beneath the Montoya Group on Mine Hill. The measured sections are plotted in Fig. 5.

Fusselman Dolomite (Silurian)

Erosional unconformity

Montoya Group

Cutter Formation

Unit		Thickness (in feet) Unit	Total
47	Dolomite, medium dark gray (N 4), weathering very light gray (N 8); aphanitic to fine crystalline; a pure, massive, non-descript dolomote forming small, non-resistant lodges; no faunal evidence preserved (maximum)	93	93

Aleman Formation

46	Dolomite, cherty, brownish black (5 YR 3/1), weathers pale yellowish brown (10 YR 5/2), with medium gray (N 5) chert weathering light brown (5 YR 6/4); fine crystalline, locally medium; chert weathers hackly and irregular in strong relief; sparse fossil hash but very small (less than 1/4 inch); forms step-like ledges	49½	142½
45	Dolomite, cherty, brownish black (5 YR 2/1), weathers pale yellowish brown (10 YR 6/2), with medium dark gray (N 4) to medium gray (N 5) chert weathering light brown (5 YR 6/4); fine to very fine crystalline; irregular, nodular chert very abundant, weathering in strong relief; fossil hash rare; forms small, step-like ledges with no bedding preserved.	66	208½
44	Dolomite, cherty, brownish black (5 YR 2/1), weathering pale yellowish brown (10 YR 6/2), with medium gray (N 5)chert weathering light brown (5 YR 5/6); fine to very fine crystalline; interbedded 1- to 3-inch dolomite and ½- to 2-inch chert layers, very continuous and parallel; chert weathers in strong relief against solution pitted dolomite; forms thick ledges with laminated to very thin bedding	107½	316

Upham Dolomite

43	Dolomite, cherty, medium dark gray (N 4) to dark gray (N 3), weathers medium gray (N 5), with medium dark gray (N 4) chert weathering light brown (5 YR 5/6); fine crystalline; abundant chert nodules and lenses, especially near top of unit; locally interclastic with rare fossil hash; forms 1- to 3-foot step-like ledges with medium bedding	19½	335½
42	Dolomite, fossiliferous, dark gray (N 3) weathering medium gray (N 5); medium crystalline; occasional brown chert nodules weather in strong relief; intraclasts intermixed with fossil debris, including brachiopods, corals, and silicified endoceroid siphuncles; forms 1- to 3-foot resistant ledges with medium bedding	35	370½

41	Dolomite, slightly sandy, medium gray (N 5), weathers medium light gray (N 6); fine crystalline; contains poorly sorted, rounded to subrounded, frosted sand grains; rare fossil hash in lenses and pods; forms single ledge with irregular medium bedding	2½	373

Cable Canyon Sandstone

40	Dolomitic sandstone, medium dark gray (N 4), weathers moderate yellowish brown (10 YR 5/4); fine crystalline; contains abundant poorly sorted, rounded to subrounded, frosted sand grains; sand content decreases near top of unit; rare corals and burrow casts; forms sheer resistant cliff with no apparent bedding	12	385
39	Dolomite, sandy, medium dark gray (N 4), weathers medium light gray (N 6); fine crystalline; contains poorly sorted, rounded to subrounded, frosted sand grains localized in lenses and stringers; burrow casts locally preserved; forms sheer cliff with no apparent bedding	4	389
	Total Montoya Group		389

Erosional unconformity; El Paso section begins on the East Hills.

El Paso Group

Mud Springs Mountain Formation

38	Limestone, fossiliferous, dark gray (N 3), weathers medium gray (N 5), with light brown (5 YR 5/6) silt intercalations weathering grayish orange (10 YR 8/4); aphanitic to fine crystalline, locally recrystallized, contains some intraclasts intermixed with fossil debris; possibly brachiopods, trilobites, and gastropods (Bridgeites, Bridgeina); forms ½- to 2-foot ledges, with thin, irregular bedding	12½	12½

Jose Formation

37	Limestone, oolitic, medium dark gray (N 4) to light gray (N 7), weathers medium dark gray		

	(N 4) to medium light gray (N 6); recrystallized, medium to coarse crystalline; dark, fetid limestone with intermixed oolites, intraclasts, and fossil debris; some brachiopods, trilobites (Aulacoparia) and gastropods; forms 1- to 2-foot ledges with thin to medium bedding	26½	39
Victorio Hills Formation			
36	Limestone, silty, pale yellowish brown (10 YR 5/2), weathers light gray (N 7), with grayish orange (10 YR 8/4) weathering silt; aphanitic, locally medium to coarse crystalline; silt abundant in irregular patches and after burrow casts; abundant cephalopods, gastropods, and brachiopods (Finkelnburgia) especially with intraclastic breccia; forms 1- to 2-foot ledges with thin to medium bedding	6	45
35	Limestone, silty, medium light gray (N 6), weathering light gray (N 7), with grayish orange (10 YR 7/4) silty zones; fine to medium crystalline; contains abundant silt and chert localized in burrow casts and in irregular, hackly intercalations weathering in strong relief; intraclasts common, especially in lenses and pods; forms thin, platy layers with thin bedding	7½	52½
34	Limestone, silty, locally cherty, light browinsh gray (5 YR 6/1), weathers light gray (N 7) to medium light gray (N 6); aphanitic, locally medium to coarse crystalline; contains silt and chert after burrow casts and in wispy, wavy intercalations; some brachiopods, gastropods, and cephalopods (Clitendoceras) associated with intraclasts in lenses and pods; nonresistant, platy outcrop with thin bedding	11½	64
33	Limestone, silty, brownish gray (5 YR 4/1), weathers light gray (N 6) to grayish orange (10 YR 7/4) where silt-rich; aphanitic to fine crystalline; contains wispy, wavy silt intercalations weathering in relief, rare fossil debris and intraclastic zones; forms step-like ledges with thin bedding	4	68

32	Limestone, medium dark gray (N 4), weathers medium light gray (N 6); medium to coarse crystalline; contains fossil hash and intraclastic breccia in large pods and lenses; forms 1- to 2-foot ledges with thin, wavy bedding	3½	71½
31	Limestone, silty, light olive gray (5 Y 6/1), weathers light gray (N 6), with patches of grayish orange (10 YR 7/4) silt; forms ½- to 1-foot thick ledges with thin to medium bedding	6	77½
30	Limestone, silty, locally cherty, medium light gray to moderate orange pink (10 R 7/4) where silt-rich, weathering medium gray (N 5) to light brown (5 YR 5/6); coarse crystalline; recrystallized; silt and chert localized in irregular, hackly intercalations; burrow casts, coarse intraclastic lenses found throughout the unit; forms thin, nonresistant layers with thin irregular bedding	5	82½
29	Limestone, silty, light brownish gray (5 YR 6/1) weathers light gray (N 7);medium to coarse crystalline; recrystallized; contains dark yellowish orange (10 YR 6/6) irregular silt intercalations weathering in strong relief; burrow casts common, along with lenses of coarse intraclasts; small, step-like ledges with thin bedding	14	96½
28	Limestone, silty, pale red (10 R 6/2) to pale yellowish brown (5 YR 6/1), weathering light gray (N 7) to grayish orange (10 YR 7/4) where silt-rich; aphanitic to fine crystalline; abundant wispy, wavy silt intercalations in strong relief; some burrow casts and intraclastic debris;rare fossil hash; forms step-like ledge with thin bedding	4	100½
27	Limestone, medium light gray (N 6), weathers light gray (N 7); fine crystalline; contains very local lenses of rounded and frosted sand grains; abundant brachiopods, gastropods, cephalopods, with spherical Girvanella algal structures; locally intraclastic; thin, nonresistant layers	5	105½

26	Limestone, silty, pale yellowish brown (10 YR 5/2), weathers pale brown (5 YR 5/2) to light gray (N 7); very fine to medium crystalline; contains irregular, hackly silt intercalations weathering in relief; locally intraclastic; burrow casts common, along with brachiopod (Diaphelasma) and gastropod hash; forms thick ledges with thin bedding	23½	129
25	Limestone, silty, moderate yellowish brown (10 YR 6/4), weathering light brown (5 YR 6/4); medium to coarse crystalline; recrystallized; silt weathers in irregular patches on solution pitted surface; sparse intraclasts and burrow casts; abundant brachiopod, gastropod, and cephalopod fragments; partial outcrop, nonresistant with thin bedding	15½	144½
24	Limestone, silty, moderate orange pink (10 R 7/4), weathers grayish orange (10 YR 7/4); medium to coarse crystalline; recrystallized; wispy, irregular silt intercalations weathering in relief; sparse fossil hash with some intraclastic lenses; thin layered outcrop with thin to medium bedding	6½	151
23	Limestone, silty, mottled pale red (5 R 6/2), weathers grayish orange pink (5 YR 7/2); aphanitic to fine crystalline; silt limited to small patches and zones; locally intraclastic; abundant gastropods, brachiopods (Diaphelasma), and piloceroid cephalopods (Stenopiloceras) weathering in relief; forms small, 1- to 2-foot ledges, with thin to medium bedding	18½	169½
22	Limestone, silty, mottled light brownish gray (5 YR 6/1) to moderate red (5 R 5/4), weathering grayish orange pink (5 YR 7/2); abundant wispy, wavy silt intercalations weathering in relief; intraclasts common with brachiopods, gastropods, endoceroid (Bisonoceras) and piloceroid cephalopods; forms step-like ledges with thin to medium bedding	9	178½
21	Limestone, silty, light brownish gray (5 YR 5/1), weathers light gray (N 7); aphanitic to fine crystalline; silt scattered in small patches		

	and lenses; burrow casts common on bedding planes; abundant endoceroid and piloceroid cephalopod siphuncles, brachiopods, and gastropods; forms 1- to 2-foot step-like ledges with thin bedding	22	200½
Cooks Formation			
20	Limestone, silty, light olive gray (5 Y 6/1) to pale yellowish brown (10 YR 6/2), weathering light olive gray (5 Y 6/1); aphanitic, locally medium to coarse crystalline; contains variable amounts of wispy, wavy silt intercalations weathering in relief; abundant fossil debris, including brachiopods, gastropods, and endoceroid cephalopods (Proendoceras); forms 1- to 3-foot ledges with thin to medium bedding	57	257½
19	Limestone, locally fossiliferous, pale red (10 R 6/2), weathering grayish orange (10 YR 7/4); coarse crystalline; recrystallized; rare silty intercalations weathering in relief; locally intraclastic, some burrow casts; abundant endoceroids, gastropods, and brachiopods; forms small, step-like ledges with thin, irregular bedding	10	267½
18	Limestone, silty, pale red (10 R 6/2), weathers grayish orange (10 YR 7/4); contains wispy, wavy silt intercalations weathering in relief; sparse gastropod, cephalopod fragments, with occasional burrow casts; forms 1- to 2-foot ledges with thin, wavy bedding	11	278½
17	Limestone, locally intraclastic, medium light gray (N 6), weathers light gray (N 7); medium to coarse crystalline; recrystallized; sparse silt intercalations in relief; abundant intraclasts, with burrow casts exposed on bedding planes; forms 1- to 3-foot step-like ledges with thin to very thin wavy bedding	13	291½
16	Limestone, silty, light brownish gray (5 YR 6/1) to pale red (5 R 6/2), weathers grayish orange (10 YR 7/4); aphanitic; dense, silty intercalations common in low relief; forms distinct ledge with very thin to laminated bedding	2	293½

15	Limestone, silty, locally intraclastic, pale red (10 R 6/2), weathers light brown (5 YR 5/6); silt abundant, especially near top of unit; intraclasts common, with some burrow casts in relief on bedding planes; forms small ledge with thin to medium irregular bedding	5	298½
14	Limestone, silty, yellowish gray (5 Y 7/1), weathering light gray (N 7); aphanitic to fine crystalline; contains wispy, wavy silt intercalations weathering in strong relief on solution pitted surface; sparse fossil debris, some burrow casts and intraclasts; forms thick, blocky ledge with thin to medium wavy bedding . .	33	331½
13	Limestone, silty, grayish orange (10 YR 7/4) to light olive gray (5 Y 6/1), weathers grayish orange (10 YR 7/4) to light olive gray (5 Y 6/1); medium to coarse crystalline; recrystallized; silt restricted to patches and lenses, although "pseudocherty" silt nodules weather in strong relief throughout the unit; some burrow casts, gastropods; small limonite pseudomorph after pyrite nodules common near the base; cliff-former, with thin to medium bedding	12	343½
12	Limestone, silty, pale red (10 R 6/2) to light gray (N 7), weathering grayish orange (10 YR 7/4) to yellowish gray (5 Y 8/1); wispy, wavy silty limestone near base grades upwards into almost pure limestone; "pseudochert" nodules common low in the unit; some intraclastic lenses and pods; forms massive, step-like ledge	13	356½
11	Limestone, silty, yellowish gray (5 Y 8/1), weathers light gray (N 7); partial outcrop; limestone is very soft, friable, with thin to very thin irregular bedding	2½	359
10	Limestone, light olive gray (5 Y 6/1), weathers pale yellowish brown (10 YR 6/2); aphanitic, locally fine to medium; recrystallized; sparse wavy silt intercalations in relief on solution pitted surface; 1 foot from top of unit is "pseudochert" lense weathering in relief; forms distinct step-like ledges with thin, wavy bedding	5	364

9	Limestone, silty, pale yellowish brown (10 YR 6/2), weathers yellowish gray (5 Y 7/2); medium crystalline; wispy, wavy silt scattered; some burrow casts on bedding planes; partial outcrop, non-resistant unit with thin wavy bedding	4	368
8	Limestone, silty, light brownish gray (5 YR 6/1), weathers light gray (N 7); fine to medium crystalline; recrystallized; contains faint wispy silt stringers especially near base; locally intra-clastic; top marked by discontinuous "pseudo-chert" lense weathering in relief; forms single ledge with thin, wavy bedding . . .	4½	372½
7	Limestone, silty, light brownish gray (5 YR 6/1) to light olive gray (5 Y 6/1), weathers grayish orange (10 YR 7/4); fine to medium crystalline; recrystallized; contains wispy, wavy silt intercalations weathering in relief, along with pods and lenses of "pseudocherty" silt zones; forms thick, step-like ledges with thin, wavy bedding	6½	379
6	Limestone, silty, light olive gray (5 Y 6/1), weathers light gray (N 7); medium to coarse crystalline; recrystallized; contains minor irregular silt intercalations; some small (1- to 3-inch) nodules of limonite pseudo-morph after pyrite; partial exposure with thin, wavy bedding	2	381
5	Limestone, silty, light brownish gray (5 R 6/2) to light olive gray (5 Y 6/1), weathering grayish orange (10 YR 7/4) with dark yellowish orange (10 YR 6/6) silt intercalations; aphanitic, locally medium crystalline; recrystallized; silt weathers in relief on solution pitted surface, burrow casts common, with some endoceroid siphuncles; forms 2-foot ledges with thin to medium bedding	14	395

Big Hatchet Formation

4	Limestone, silty, locally cherty, pale red (5 R 6/2) to light brownish gray (5 YR 6/1), weathers pale yellowish brown (10 YR 6/2);		

	medium to coarse crystalline; recrystallized; silt weathers in wispy, wavy stringers; conspicuous ½- to 2-inch "pseudocherty" to cherty lenses and nodules weathering in strong relief; top of unit marked by 2-inch black chert layer; 10 feet above base of unit is a 2-foot thick dioritic to diabasic sill; forms 1- to 3-foot step-like ledges with thin, wavy bedding	30½	425½
3	Limestone, silty, cherty, light brownish gray (5 YR 6/1), weathers light gray (N 7) to medium light gray (N 6), with light brown (5 YR 6/2) silt; aphanitic to very fine crystalline; contains wispy, wavy silt intercalations weathering in relief; rare fossil debris; some burrow casts on bedding planes; forms 1- to 2-foot ledges with thin, wavy bedding	44	469½
2	Limestone, silty, light brownish gray (5 YR 6/1) to pale red (5 R 6/2), weathers pale yellowish brown (10 YR 6/2) to dark yellowish brown (10 YR 4/2); fine to medium crystalline; recrystallized; contains abundant wispy, wavy silt intercalations weathering in relief; some burrow casts visible on bedding planes; forms 2- to 4-foot thick ledges, with thin to very thin, wavy bedding	29½	499
1	Limestone, silty, pale yellowish brown (10 YR 6/2), weathering light gray (N 7), with grayish orange (10 YR 7/4) silt; aphanitic to very fine crystalline; contains irregular silty intercalations weathering in relief; partial outcrop; small nonresistant thin-bedded layers	5	504
	Total El Paso Group		504

Low angle fault

Montoya Group

Snake Hills

Three separate traverses were made in the Snake Hills to measure the El Paso and Montoya Groups. The Victorio Hills and the Jose Formations were measured on the eastern-most hill (NW1/4 SE 1/4 sec. 34, T. 24 S., R. 10 W.), while the Mud Springs Mountain and Snake Hills Formations were measured on the highest hill in the group (SW 1/4 NW 1/4, sec. 34, T. 24 S., R. 10 W.) (both are located on the Bowlin Ranch, New Mexico, 7.5 - minute quadrangle, 1965). The Montoya Group is best exposed in the western cluster of hills, and was measured on the largest hill in that group (SW 1/4 SW 1/4 sec. 33, T. 24 S., R. 10 W.) (Red Mountain, New Mexico, 7.5 - minute quadrangle, 1965). The three traverses are plotted on Figure 10.

No higher exposures on hill

Montoya Group

Aleman Formation

Unit		Thickness (in feet) Unit	Total
46	Dolomite, cherty, medium dark gray (N 4), weathers pale yellowish brown (10 YR 6/2), with grayish red (5 R 4/2) chert weathering pale reddish brown (10 R 5/4); very fine crystalline; contains abundant chert layers and lenses weathering in strong relief which increase in content upsection, but become irregular and nodular; locally faulted unit; forms steep cliff with thin, irregular bedding	86	86
45	Dolomite, cherty, medium dark gray (N 4), weathering pale yellowish brown (10 YR 5/2), with grayish red (5 R 4/2) chert weathering pale red (5 R 6/2) in strong relief; very fine crystalline; 2- to 4-inch layers of		

	dolomite interlayed with 2- to 5-inch layers of chert; forms steep ledges with thin bedding	38	124
Upham Dolomite			
44	Dolomite, medium dark gray (N 4), weathers pale yellowish brown (10 YR 6/2); fine to medium crystalline; contains irregular stringers of silt that are locally silicified; sparse recrystallized fossil debris found near base; forms sheer cliff with no apparent bedding	22	146
43	Dolomite, fossiliferous locally, brownish gray (5 YR 4/1), weathers pale yellowish brown (10 YR 6/2); medium to coarse crystalline; small, recrystallized fossil debris locally abundant, possibly brachiopod and gastropod fragments; forms sheer cliff with no bedding preserved	29½	175½
42	Dolomite, slightly sandy, brownish gray (5 YR 4/1), weathers moderate yellowish brown (10 YR 5/4); fine to medium crystalline; contains poorly sorted, rounded to subrounded, frosted sand grains especially in stringers and lenses; forms sheer cliff with overlying units; no apparent bedding	3	178½
Cable Canyon Sandstone			
41	Dolomite, sandy, light brownish gray (5 YR 6/1), weathers pale yellowish brown (10 YR 6/2); fine crystalline; contains poorly sorted, rounded to subrounded frosted sand grains locally concentrated in lenses; top of unit marked by dense, 2-inch lense of sand weathering black; forms cliff with no bedding preserved	10	188½
40	Dolomite sandstone, grayish orange pink (5 YR 7/2), weathers light brown (5 YR 5/6); minor fine crystalline dolomitic cement; contains abundant poorly sorted, rounded to subrounded, frosted sand grains; forms sheer clif with no apparent bedding	16	204½
	Total Montoya Group		204½

Erosional unconformity; El Paso section begins in the eastern hills.

El Paso Group

Snake Hills Formation

39	Limestone, fossiliferous, brownish gray (5 YR 4/1), weathers light gray (N 7); aphanitic, locally medium crystalline; recrystallized; contains scattered irregular chert, possible after burrow casts; abundant gastropods, brachiopods, cephalopods, and silicified sponges; forms resistant cliff on top of hill with thin, wavy bedding . . .	11½	11½
38	Limestone, silty, fossiliferous, mottled moderate red (5 R 4/6) to brownish gray (5 YR 4/1), weathers dark yellowish orange (10 YR 7/6); aphanitic, locally medium crystalline; recrystallized; silt weathers in patches on solution pitted surface; abundant gastropods, cephalopods, and sponges (Archaeosouphia); forms single ledge with thin, wavy to irregular bedding	2	13½
37	Limestone, cherty, fossiliferous, brownish gray (5 YR 4/1), weathering light gray (N 7); contains hackly, knobby chert intercalations in strong relief; abundant gastropods, cephalopods, brachiopods; locally intraclastic; thick, cliff-forming unit with thin, wavy bedding	15	28½
36	Limestone, fossiliferous, brownish gray (5 YR 4/1), weathers light gray (N 7); aphanitic, locally fine crystalline; fossil hash common, some gastropod, cephalopod, and brachiopod fragments; forms small, step-like ledges with thin, irregular bedding	4	32½
35	Limestone, silty, fossiliferous, yellowish gray (5 Y 7/6) to grayish red (5 R 4/2), weathering grayish orange (10 YR 7/4); aphanitic, locally fine crystalline; silt common in smooth patches and lenses; abundant cephalopods, flat and high spired gastropods, and brachiopods, especially in channel fill; forms single ledge with thin, wavy bedding	2½	35

34	Limestone, fossiliferous, brownish gray (5 YR 4/1), weathers light gray (N 6.5); aphanitic; contains sparse irregular chert intercalations; abundant fossil debris, including flat and high spired gastropods, cephalopods, and brachiopods; locally intraclastic; forms small ledges with thin, irregular bedding	5	40
33	Limestone, fossiliferous, brownish gray (5 YR 4/1), weathering light bluish gray (5 B 7/1); aphanitic; abundant flat and high spired gastropods, brachiopods, and cephalopods; forms small ledges, locally platy, with thin, irregular bedding	5½	45½
32	Limestone, silty, fossiliferous, brownish gray (5 YR 4/1), weathers light gray (N 7), with grayish orange (10 YR 7/4) silt; aphanitic; contains irregular patches and zones of silty intercalations; fossil hash common including gastropod, brachiopod, and cephalopod fragments; forms single ledge with thin, wavy bedding	2	47½
31	Limestone, locally fossiliferous, brownish gray (5 YR 4/1), weathering medium light gray (N 6); scattered small fossil hash present; partial exposure; forms non-resistant slope with thin bedding	7	54½
30	Limestone, silty, fossiliferous, mottled grayish red (5 R 4/2), weathers grayish orange (10 YR 7/4); aphanitic; silt concentrated in smooth patches and zones; fossil hash common but small, including gastropod, brachiopod, and cephalopod (Clitendoceras) fragments; forms single ledge with thin to laminated bedding	2	56½
29	Limestone, fossiliferous, locally cherty, brownish gray (5 YR 5/1), weathers light bluish gray (5 B 7/1); aphanitic; rare silt intercalations; some chert nodules in middle of unit; brachiopods, cephalopods, and gastropods common; forms 1- to 3-foot step-like ledges with thin, wavy bedding	12	68½
28	Limestone, silty, fossiliferous, mottled grayish red (5 R 4/2), weathers grayish orange (10 YR 7/4);		

	aphanitic; silt scattered in smooth patches; fossil hash common but small, possibly gastropod and brachiopod fragments; partial exposure, single ledge with very thin to laminated bedding	6½	75
27	Limestone, fossiliferous, brownish gray (5 YR 5/1), weathers light gray (N 6.5); aphanitic; contains sparse wispy, wavy silt intercalations weathering in relief; rich fossil content, including cephalopods, gastropods, trilobites, and sponges; forms step-like ledges with thin, wavy bedding	7	82
26	Limestone, cherty, fossiliferous, brownish gray (5 YR 4/1), weathering light gray (N 7), with light brown (5 YR 5/6) chert; aphanitic; contains chert nodules and lenses in strong relief; top of unit marked by 2-inch dark brown chert layer; abundant small fossil hash, locally stromatolitic; forms thin platy layers at base, grading upwards into more resistant ledge with thin, irregular bedding	3	85
25	Limestone, silty, fossiliferous, light brownish gray (5 YR 5/1), weathers light gray (N 7), with grayish orange (10 YR 7/4); silt; aphanitic; contains wispy, wavy silt intercalations, also filling burrow casts; abundant fossil debris, including brachiopods, gastropods (Maclurites), cephalopods, and algal stromatolites; locally intraclastic; forms thick ledges near the base and top with thin, platy layers in center of unit	12	97
24	Limestone, cherty, medium light gray (N 6), weathers light gray (N 7), with light brown (5 YR 5/6) chert; aphanitic; contains hackly chert pods and lenses weathering in strong relief; sparse fossil hash; forms sheer cliff with thin, irregular bedding	9	106
23	Limestone, fossiliferous, light brownish gray (5 YR 6/1), weathers pale blue (5 PB 7/2); aphanitic; contains minor wispy, wavy silt intercalations in relief on solution pitted surface; abundant fossil debris, including brachiopods, gastropods (Proliospira), and cephalopods; forms 3-foot ledges with thin wavy bedding	10	116

22	Limestone, cherty, brownish gray (5 YR 4/1), weathers moderate yellowish brown (10 YR 5/4), with dusky brown (5 YR 2/2) chert; aphanitic; contains abundant hackly, irregular chert nodules and lenses weathering in strong relief; fossil hash scattered and small (less than ½ inch); forms single thick ledge with thin, irregular bedding	6	122
21	Limestone, silty, fossiliferous, pale yellowish brown (10 YR 6/2), weathers light gray (N 7) with grayish orange (10 YR 7/4) silt; aphanitic, locally fine crystalline; contains wispy, wavy silt intercalations, sometimes filling burrow casts; locally stromatolitic, with some gastropods and brachiopods; forms 1- to 3-foot step-like ledges with thin to very thin wavy bedding	16	138
20	Limestone, locally fossiliferous, dark yellowish brown (10 YR 4/2), weathers grayish orange (10 YR 7/4); aphanitic, locally fine crystalline; contains scattered irregular silt intercalations weathering in relief; some gastropod, brachiopod, and cephalopod debris; forms 1- to 2-foot ledges near base and top, with less resistant thin bedded central layers	7	145
Mud Springs Mountain Formation			
19	Limestone, silty, intraclastic, locally fossiliferous, brownish gray (5 YR 4/1), weathers light gray (N 6.5); aphanitic, locally coarse crystalline; recrystallized; contains hackly, irregular silt intercalations throughout unit; locally intraclastic; some cross-bedding; abundant brachiopods, gastropods, and cephalopods, with algal stromatolites locally developed; cliff-former, with up to 5-foot ledges; bedding thin to laminated, wavy and irregular	10	155
18	Limestone, silty, fossiliferous, olive gray (5 Y 5/1) to pale red (5 R 5/2), weathering light bluish gray (5 B 7/1); aphanitic, locally recrystallized; contains		

	scattered silt intercalations, locally after burrow casts; fossil debris includes brachiopods, cephalopods, and abundant gastropods (Bridgeites); partial exposure; forms ½-foot ledges with thin to laminated bedding	23½	178½
Transition zone			
17	Limestone, intraclastic, medium dark gray (N 4), weathering medium light gray (N 6); aphanitic, locally fine to medium crystalline; recrystallized; contains abundant aphanitic intraclasts, ½-to 1½-inches long; some cephalopods, gastropods, and brachiopods, locally silicified; forms nonresistant slope with thin,irregular bedding	7	185½
16	Limestone, silty, intraclastic, moderate red (5 R 5/4), weathering pale reddish brown (10 R 6/4), with medium gray (N 5) intraclasts weathering light gray (N 7); aphanitic to very fine crystalline; contains abundant blade and roller intraclasts up to 4 inches long; silty limestone is interlayered with intraclastic zones; forms single resistant ledge with irregular thin to medium bedding	4	189½
15	Limestone, intraclastic, medium dark gray (N 4), weathers light gray (N 6); medium to coarse crystalline; recrystallized; intraclasts common, up to 2 inches long; sparse fossil debris; nonresistant slope-former with thin, irregular bedding	11	200½
Jose Formation			
14	Limestone, silty, oolitic, medium gray (N 5), weathers light gray (N 7); aphanitic to fine crystalline; silty patches and zones especially common near top of unit; contains abundant oolites intermixed with gastropod, trilobite, brachiopod, and cephalopod fragments; forms distinct 1- to 3-foot ledges with thin-bedded, less resistant layers	5	205½

13	Limestone, silty, fossiliferous, pale red (5 R 6/2), weathering grayish orange (10 YR 7/4); aphanitic; silty layers interbedded with lenses of fossil debris; abundant gastropods, trilobites, and cephalopods; forms single ledge with thin irregular bedding	2	207½
12	Limestone, oolitic, medium light gray (N 6), weathers light gray (N 7); medium crystalline; recrystallized; oolites common, associated with ¼-inch spherical Girvanella algal structures; sparse fossil hash; partial outcrop; soft, friable, nonresistant unit with thin irregular bedding	7	214½
11	Limestone, silty, oolitic, grayish red (10 R 4/2), weathers grayish orange (10 YR 7/4); aphanitic; silt scattered throughout unit in faint stringers; oolites common, associated with fossil hash; forms single ledge with very thin bedding	2½	217
10	Interbedded oolitic limestone and silty dolomite; limestone is light brownish gray (5 YR 6/1), weathering pale brown (5 YR 5/2), while dolomite is grayish red (5 R 4/2), weathering grayish orange pink (5 YR 7/2); aphanitic, locally medium crystalline; recrystallized; oolites abundant in limestone; fossil debri scattered, some Girvanella algal structures; dolomite forms 1- to 2-foot ledges, interlayered with nonresistant thin-bedded limestone	16½	233½
Victorio Hills Formation			
9	Dolomite, light brownish gray (5 YR 6/1), weathers grayish orange (10 YR 7/4); aphanitic to very fine crystalline; contains scattered silicified cephalopod siphuncles (Bisonoceras), gastropods, and brachiopods weathering in relief; forms 1- to 3-foot ledges with vague thin bedding	26½	260
8	Dolomite, fossiliferous, brownish gray (5 YR 4/1), weathering grayish orange (10 YR 7/4); fine crystalline; contains small (less than ½-inch) silicified fossil fragments, including gastropods, brachiopods,		

	and some larger (3 to 4 inches) cephalopod siphuncles (Baschoceras); nonresistant slope-former with no apparent bedding	30	290
7	Dolomite, light brownish gray (5 YR 5/1), weathers light olive gray (5 Y 6/1); fine to medium crystalline; scattered fossil debris, some endoceroid and piloceroid (Mesopiloceras) siphuncles, silicified and weathering in relief; forms 1- to 3-foot step-like ledges with vague thin bedding	33	323
6	Dolomite, silty, mottled pale red (5 R 6/2), weathers grayish orange (10 YR 7/4); fine to medium crystalline; rare fossil debris, possibly faint burrow casts; forms 1- to 2-foot step-like ledges with thin to very thin bedding	6	329
5	Dolomite, silty, light brownish gray (5 YR 5/1), weathering grayish orange (10 YR 7/4); very fine crystalline; contains wispy, wavy silt intercalations weathering in relief; nonresistant, slope-former with thin to very thin bedding . . .	8	337
4	Dolomite, light brownish gray (5 YR 6/1), weathers yellowish gray (5 Y 7/2); medium crystalline; sparse silicified fossil debris, possibly gastropod and cephalopod fragments; occasional chert nodules near base; forms 1- to 2-foot step-like ledges with very thin to laminated bedding	13	350
3	Dolomite, silty, mottled pale red (5 R 6/2), weathers grayish orange (10 YR 7/4); medium crystalline; silt scattered in lenses and stringers; rare fossil debris, faint burrow casts on bedding planes; forms 1- to 2-foot ledges with thin to very thin bedding	7	357
2	Dolomite, silty, cherty, light brownish gray (5 YR 6/1), weathering light olive gray (5 Y 6/1); medium crystalline; contains white to gray chert nodules weathering in relief; some burrow casts near top of unit; nonresistant slope-former with thin bedding	4	361

1	Dolomite, fossiliferous, light brownish gray (5 YR 5/1), weathers light olive gray (5 Y 6/1); medium crystalline; silicified fossil debris common, including brachiopods, gastropods, and cephalopods, partial outcrop; forms 1- to 2-foot ledges with medium bedding	10	371
	Total El Paso Group .		371

Alluvium

Big Florida Mountains

The Ordovician section in the Big Florida Mountains was measured at Capitol Dome on the northwest flank of the range (NE 1/4 SE 1/4 sec. 10, T. 25 S., R. 8 W.) (Capitol Dome, New Mexico, 7.5 - minute quadrangle, 1965). The base of the section is located 1200 feet beneath the top of Capitol Dome, and exhibits a gradational contact with the underlying Bliss Sandstone. The El Paso Group is offset 140 feet below the top of the section, therefore measurement is continued in the arroyo directly south of the first traverse. The Montoya Group is best exposed 960 feet below Capitol Dome and 800 feet south of the first traverse. The locations of the traverses are plotted on Figure 11.

Lobo Formation (age unknown)

Erosional unconformity

Montoya Group

Aleman Formation

Unit		Thickness (in feet) Unit	Total
90	Dolomitic limestone, locally cherty, olive gray (5 Y 4/1), weathering light gray (N 6); very fine to medium crystalline; contains irregular chert lenses and pods up to 4 inches thick; abundant silicified fossil debris, including brachiopods and gastropods (Zygospira); forms a resistant ledge with thin, irregular bedding	11	11
89	Dolomitic limestone, light gray (N 7), weathering very light gray with moderate brown (5 YR 4/4) chert lenses; medium crystalline, very friable; chert weathers in hackly and irregular lenses; forms 1- to 3-foot thick nonresistant ledges with thin to medium bedding	30	41
88	Calcareous dolomite, cherty, locally fossiliferous, medium gray (N 5), weathering light gray (N 7), with chert weathering moderate brown (5 YR 4/4); very fine crystalline to aphanitic; chert occurs in nodules and discontinuous lenses; fossils abundant, including gastropods and brachiopods (Hypsiptycha); step-like ledge with laminated bedding	21	62
87	Calcareous dolomite, cherty, dolomite is dark gray (N 3), weathering medium gray (N 5), while chert is medium dark gray (N 4), and weathers moderate brown (5 YR 4/4); alternating layers of chert and dolomite, with chert weathering in strong relief in 1- to 3-inch layers; forms 2- to 5-foot ledges with laminated bedding	50	112
Upham Dolomite			
86	Dolomite, intraclastic, locally fossiliferous, mottled medium dark gray (N 4) to medium gray (N 5), weathering medium dark gray (N 4) to pale yellowish brown (10 YR 6/2); fine to medium crystalline;		

	fetid, with intraclasts common in zones; scattered fossil fragments, including gastropods, brachiopods (Lepidocyclus), and cephalopods; forms sheer resistant cliff with medium bedding	16	128
85	Dolomite, slightly silty, dark gray (N 3), weathers medium dark gray (N 4); fine crystalline; fetid dolomite with rare zones of silty dolomite; sparse fossil debris; forms sheer, massive cliff	12	140
84	Dolomite, locally fossiliferous, dark gray (N 3), weathers same; fine crystalline, locally coarse where fossil rich; fetid dolomite with scattered recrystallized fossil debris; forms massive cliff	13	153

Cable Canyon Sandstone

83	Dolomite, sandy, medium gray (N 5) to medium dark gray (N 4), weathers medium gray (N 5); medium crystalline; contains poorly sorted, subangular to rounded, frosted sand grains; exhibits sharp unconformity with overlying Upham Dolomite; forms sheer resistant cliff with no apparent bedding	29	182
82	Dolomite, sandy, dark gray (N 3), weathering olive gray (5 Y 3/1); fine crystalline; contains poorly sorted, subangular to rounded, frosted sand grains; massive, sheer cliff-former	4½	186½
	Total Montoya Group . . .		186½

Line of section moved 400 feet north to measure the El Paso Group. A minor erosional unconformity separates the El Paso and Montoya Groups.

El Paso Group

Scenic Drive Formation

81	Limestone, cherty, medium dark gray (N 4), weathering moderate reddish brown (10 R 4/6) to grayish brown (5 YR 3/2); fine crystalline; contains abundant nodular chert weathering in strong relief; forms 2- to 4-foot step-like ledges with thin, irregular bedding	24	24

80	Limestone, cherty, locally intraclastic, medium dark gray (N 4), weathering medium light gray (N 6) with light brown (5 YR 5/6) silty zones; fine crystalline, locally aphanitic; contains hackly chert intercalations in strong relief; lenses and zones of intraclasts common; forms thin slabs and plates with thin, irregular bedding	13½	37½
79	Limestone, silty, light olive gray (5 Y 5/1), weathering light brown (5 YR 5/6); aphanitic, locally medium crystalline; contains irregular silt intercalations; some flat gastropods, brachiopods, cephalopods, and trilobites; single, resistant ledge with thin, irregular bedding	5½	43
78	Limestone, cherty, silty, locally intraclastic, dark gray (N 4) to grayish orange (10 YR 7/4), weathering pale blue (5 PB 7/2) with moderate reddish orange (10 R 4/6) silt; aphanitic; contains irregular, hackly silt intercalations weathering in strong relief; locally cherty; intraclasts in lenses and pods; sparse fossil debris, including brachiopods, gastropods, and trilobites; forms 1- to 3-foot step-like ledges with thin, irregular bedding	15½	58½
77	Limestone, silty, mottled dark yellowish brown (10 YR 5/2) to medium dark gray (N 4), weathering grayish orange (10 YR 7/4); aphanitic; silty intercalations weather in mild relief; forms single ledge with thin, irregular bedding	4½	63
76	Limestone, cherty, medium dark gray (N 4), weathering medium light gray (N 6); very fine to fine crystalline; contains cherty intercalations in strong relief on exposed surface; forms 2- to 5-foot ledges with thin, erratic bedding	25½	88½
75	Limestone, silty, cherty, locally intraclastic, medium gray (N 5), weathers light bluish gray (5 B 7/1); aphanitic, locally fine crystalline; intraclasts common in lenses and channel fill; locally silty; abundant fossil debris, including flat and high spired gastropods, brachiopods,		

	trilobites (Pseudocybele), and silicified cephalopod siphuncles; forms 2- to 4-inch knobby slabs with thin, irregular bedding	29½	118
74	Limestone, silty, mottled grayish red (5 R 4/2), weathers grayish orange (10 YR 7/4); aphanitic; silt weathers in smooth patches on solution pitted surface; contains rare fossil hash; forms single resistant ledge with thin, irregular bedding	2½	120½
73	Limestone, dark gray (N 3), weathers light gray (N 7); aphanitic, locally recrystallized; rare fossil hash in lenses and pods, possibly brachiopod, gastropod, and cephalopod fragments; forms thin, 2- to 3-inch layers reflecting bedding; nonresistant unit	11½	132
72	Limestone, intraclastic, grayish black (N 2), weathering dark gray (N 3), very fine to fine crystalline; intraclasts abundant, up to 5 inches long, oriented parallel to bedding; thick, 2- to 4-foot ledge-former; bedding thin to medium	8	140
71	Limestone, intraclastic, medium dark gray (N 4) to medium gray (N 5), weathers pale blue (5 PB 7/2); medium to coarse crystalline; recrystallized; contains abundant intraclasts, usually less than ½ inch in diameter; rare fossil debris, possibly gastropod and brachiopod fragments; forms thin ½- to 1-foot plates and slabs reflecting thin, irregular bedding	24	164
McKelligon Canyon Formation			
70	Limestone, locally fossiliferous, medium dark gray (N 4), weathering pale blue (5 PB 7/2); aphanitic, locally fine crystalline; gastropods, brachiopods, and occasional silicified cephalopod siphuncles present; forms thin plates and slabs, with thin, irregular bedding	3½	167½
69	Dolomitic limestone, silty, mottled dark brown (10 YR 4/2) to medium gray (N 5), weathers grayish orange (10 YR 7/4); silt weathers in smooth patches, single ledge with thin, wavy bedding	1	168½

68	Limestone, fossiliferous, locally intraclastic, medium dark gray (N 4), weathers medium gray (N 5); coarse crystalline, recrystallized; intraclastic channel fill common; contains silicified fossils, including cephalopod siphuncles, gastropods, and sponges (Archaeosouphia); single ledge with no apparent bedding	4	172½
67	Limestone, intraclastic, locally stromatolitic, medium dark gray (N 4), weathers pale blue (5 PB 7/2); aphanitic, locally medium to coarse crystalline; intraclasts localized in lenses and pods with fossil debris; abundant cephalopod siphuncles, sponges (Archaeosouphia), and gastropods, along with stromatolitic algal heads; forms thin ledges with thin, irregular bedding	2½	175
66	Dolomitic limestone, silty, intraclastic, medium gray (N 5) to mottled pale yellowish brown (10 YR 5/6), weathering mottled pale blue (5 PB 7/2) to grayish orange (10 YR 7/4); aphanitic to fine crystalline; originally a silty, fossil-rich unit with brachiopods and cephalopods, but eroded up to 4-feet deep and filled with intraclasts and fossil hash; forms single ledge with obscured bedding	6	181
65	Limestone, silty, intraclastic, medium dark gray (N 4), weathers pale blue (5 PB 7/2); aphanitic to fine crystalline; abundant intraclastic pods and lenses, with irregular hackly silt intercalations weathering light brown (5 YR 5/6) in strong relief; sparse sponge, gastropod, and brachiopod debris; forms thin, platy layers with thin to laminated wavy bedding	6½	187½
64	Limestone, interbedded silty fossiliferous and intraclastic fossiliferous, silty layers are mottled dark yellowish brown (10 YR 6/2) to medium dark gray (N 4), weathering grayish orange (10 YR 7/4), while intraclastic layers are medium dark gray, weathering pale blue (5 PB 7/2); aphanitic to fine crystalline; intraclasts and silt restricted to particular layers; occasional silicified siphuncles and sponges; intraclastic layers form 1- to 3-foot ledges, while silty layers less resistant with thin, wavy bedding	17½	205

63	Limestone, fossiliferous, intraclastic, dark gray (N 3), weathering pale blue (5 PB 7/2); aphanitic, locally very fine crystalline; intraclastic channel fill common; scattered fossil debris, including brachiopods, gastropods, and cephalopods, with some silicified burrow casts; forms step-like ledges with thin, knobby bedding	19½	224½
62	Dolomitic limestone, silty, fossiliferous, pale red (5 R 6/2), weathering grayish orange (10 YR 7/4); aphanitic to very fine crystalline; silt weathers in smooth patches on solution pitted surface; small fossil debris common, probably gastropods and brachiopods; single ledge with thin, wavy bedding	3½	228
61	Limestone, cherty, dark gray (N 3), weathers pale blue (5 PB 7/2); aphanitic, locally fine crystalline; contains irregular, knobby chert weathering in strong relief; rare fossil fragments; forms 1- to 2-foot ledges with thinner, nonresistant layers	10	238
60	Limestone, silty, fossiliferous, mottled moderate red (5 R 4/4), weathering grayish orange pink (5 YR 7/2); aphanitic, locally recrystallized where fossil rich; silt weathers in smooth patches between fossiliferous lenses and pods, mainly gastropod and brachiopod fragments; forms single ledge with thin bedding .	2	240
59	Limestone, cherty, medium dark gray (N 4), weathering medium light gray (N 6); aphanitic to fine crystalline; contains reddish brown (10 R 4/6) chert nodules and lenses, especially near the base; burrow casts common; forms step-like ledges with thin, irregular bedding . .	5½	245½
58	Calcareous dolomite, silty, pale red (5 R 6/2), weathers dark yellowish orange (10 YR 6/6) to moderate orange (10 R 7/4); aphanitic, locally very fine crystalline; silt common throughout unit; forms single resistant ledge with thin, wavy bedding	2½	248

57	Limestone, interbedded silty intraclastic and fossiliferous intraclastic; silty layers mottled grayish red (5 R 4/2), weathering grayish orange pink (5 YR 6/2), while fossiliferous layers are medium gray (N 5), weathering pale blue (5 PB 7/2); aphanitic, coarse crystalline where intraclastic; intraclastic channel fill occurs up to 3-feet thick; fossils abundant, including gastropods, brachiopods, sponges, and cephalopods; silty layers, nonresistant, less than ½-foot thick; intraclastic layers form 1- to 2-foot ledges with wavy, irregular bedding	24	272
56	Interbedded intraclastic, fossiliferous limestone, and silty fossiliferous dolomitic limestone; intraclastic layers are dark gray (N 3), weathering pale blue (5 PB 7/2), while silty zones are pale red (5 R 6/2), weathering grayish orange (10 YR 7/4); aphanitic locally fine to medium crystalline; small intraclasts common in distinct lenses and layers; fossil debris includes gastropods, brachiopods, trilobites, and cephalopods; thin, nonresistant silty layers are interbedded with 1- to 2-foot intraclastic layers; bedding thin and irregular	25	297
55	Dolomitic limestone, silty, mottled medium dark gray (N 4) to pale brown (5 YR 5/2), weathers grayish orange (10 YR 7/4); aphanitic, locally recrystallized; contains irregular and hackly silt intercalations weathering in relief; minor gastropod and brachiopod debris; forms single ledge with thin, irregular bedding	4	301
54	Limestone, fossiliferous, intraclastic, medium dark gray (N 4), weathers medium gray (N 5) to medium light gray (N 6); medium to coarse crystalline; recrystallized; intraclasts ½- to 3-inches long abundant, especially near top of unit some brachiopods, gastropods, and silicified cephalopods and sponges; forms 2- to 4-foot ledges with thin, wavy bedding	13	314

53	Limestone, silty, medium dark gray (N 4), weathers medium gray (N 5); aphanitic to fine crystalline; contains "pseudocherty" silt nodules weathering reddish brown (10 R 4/6) in strong relief; gastropods, brachiopods, and silicified cephalopod siphuncles common; forms single ledge with thin, wavy bedding	3	317
52	Limestone, silty, fossiliferous, medium gray (N 5), weathering pale blue (5 PB 7/2); aphanitic; silt abundant in wispy, wavy intercalations; abundant fossil debris includes gastropods, brachiopods, and silicified cephalopod siphuncles and sponges (Archaeosouphia); forms ½- to 2-foot layers with thin, wavy bedding	14½	331½
51	Limestone, silty, fossiliferous, mottled light brown (5 YR 6/4), weathers grayish orange (10 YR 7/4); aphanitic, silt weathers in irregular patches; abundant small (less than ¼-inch) fossil hash; forms single ledge with thin, wavy bedding	1½	333
50	Limestone, fossiliferous, medium dark gray, weathers pale blue (5 PB 7/2); aphanitic; abundant small brachiopod, gastropod, and cephalopod fragments; forms plates and slabs with thin, irregular bedding	5	338
49	Limestone, silty, fossiliferous, mottled reddish orange (10 R 6/6) to medium dark gray (N 4), weathers grayish orange (10 YR 7/4); aphanitic, locally very fine crystalline; silt weathers in patches on solution pitted surface; brachiopod, gastropod, and cephalopod hash common; forms single ledge with thin, irregular bedding	1½	339½
48	Limestone, fossiliferous, dark gray (N 3), weathering pale blue (5 PB 7/2); aphanitic, locally recrystallized; abundant fossil debris, including gastropods, brachiopods, and cephalopods; forms 1-foot ledges with some platy layers; bedding thin and irregular	13	352½

47	Limestone, silty, fossiliferous, mottled medium dark gray (N 4) to dark yellowish brown (10 YR 4/2), weathering dark yellowish orange (10 YR 6/6); aphanitic to very fine crystalline; contains silty intercalations weathering in smooth patches on solution pitted surface; some brachiopod, cephalopod, and gastropod hash present; single ledge-former with thin, irregular bedding	2	354½
46	Limestone, fossiliferous, medium dark gray (N 4) to medium gray (N 5), weathers pale blue (5 PB 7/2); aphanitic, locally fine crystalline; contains scattered "pseudocherty" silty nodules, especially near base; abundant silicified high spired gastropods, cephalopod siphuncles, and sponges (Archaeosouphia); forms 1- to 3-foot step-like ledges with thin, wavy bedding	24	378½
45	Limestone, silty, fossiliferous, mottled olive gray (5 Y 4/1) to moderate red (5 R 5/4), weathering grayish orange (10 YR 7/4); abundant silt occurs in patches and lenses; fossil debris common, including brachiopods, gastropods, and silicified cephalopod siphuncles; single ledge-former with thin, irregular bedding	1	379½
44	Limestone, silty, fossiliferous, dark gray (N 3), weathering pale blue (5 PB 7/2); aphanitic, locally very fine crystalline; silt common in patches; abundant flat and high spired gastropods, brachiopods, and silicified cephalopod siphuncles; forms 1- to 3-foot resistant ledges with thin, wavy bedding	15½	395
43	Limestone, silty, fossiliferous, mottled olive gray (5 Y 5/1), weathers grayish orange (10 YR 7/4); aphanitic, locally very fine crystalline; contains abundant silt intercalations in patches and lenses; abundant small (less than ½-inch) fossil debris; single ledge-former with thin, wavy bedding	1½	396½

42	Limestone, silty, fossiliferous, locally intraclastic, medium dark gray (N 4), weathering light bluish gray (5 B 7/1); aphanitic to very fine crystalline; silt localized in lenses; intraclastic channel fill common, especially with fossil debris, including flat and high spired gastropods, brachiopods, and cephalopods; forms 1- to 4-foot ledges with thin, irregular bedding	16½	413
41	Limestone, silty, fossiliferous, mottled medium dark gray (N 4) to light olive gray (5 Y 6/1), weathering grayish orange (10 YR 7/4); aphanitic, locally fine crystalline; contains patches of silty intercalations interlayered with brachiopod (Diparelasma), gastropod, and cephalopod debris; single ledge with thin, irregular bedding	1½	414½
40	Limestone, silty, fossiliferous, medium dark gray (N 4), weathering pale blue (5 PB 7/2); aphanitic, locally recrystallized; contains silt in lenses and pods; locally intraclastic; abundant fossil debris, including brachiopods, flat and high spired gastropods, and silicified cephalopod siphuncles; forms step-like ledges, locally thin and platy with thin, wavy bedding	20	434½
39	Limestone, silty, fossiliferous, mottled medium dark gray (N 4) to pale yellowish brown (10 YR 5/2), weathering grayish orange (10 YR 7/4); aphanitic, locally fine to coarse crystalline; recrystallized; patches and lenses of silt are common, with minor sand; fossil hash abundant but small (less than ½-inch); single, resistant ledge with thin, wavy bedding	2	436½

Snake Hills Formation

38	Limestone, fossiliferous, dark gray (N 3), weathers pale blue (5 PB 7/2); aphanitic to very fine crystalline; abundant flat and high spired gastropods, some brachiopods, and silicified cephalopod siphuncles; forms 1- to 4-foot thick ledges, with discontinuous bedding	16½	453

37	Limestone, silty, intraclastic, mottled medium dark gray (N 4) to light olive gray (5 Y 5/2), weathers pale blue (5 PB 7/2) with light brown (5 YR 5/6) irregular and hackly silt intercalations in strong relief; aphanitic, locally fine crystalline; aphanitic intraclasts abundant but small (less than ½-inch); forms single ledge with thin, irregular bedding	2	455
36	Limestone, fossiliferous, intraclastic, dark gray (N 3), weathers pale blue (5 PB 7/2); aphanitic, locally fine to medium crystalline, recrystallized; intraclasts abundant in channel fill; fossils common, including gastropod, brachiopod, and trilobite fragments; forms thick, step-like ledges with thin bedding	23½	478½
35	Limestone, silty, mottled olive gray (5 Y 4/1) weathers grayish orange (10 YR 7/4); aphanitic; patches of silty intercalations weather out on solution pitted surface; single resistant ledge with thin, irregular bedding	1	479½
34	Limestone, fossiliferous, dark gray (N 3), weathers light bluish gray (5 B 7/1); aphanitic, locally fine crystalline; abundant gastropods, cephalopods, brachiopods, and trilobites; weathers in thin ½- to 1-foot slabs with wavy and irregular bedding	14½	494
33	Limestone, silty, fossiliferous, mottled medium dark gray (N 4) to medium gray (N 5), weathering grayish orange (10 YR 7/4); aphanitic; silt patches scattered throughout unit; fossil hash abundant but small (less than ½-inch); forms single ledge	1½	495½
32	Limestone, fossiliferous, intraclastic, dark gray (N 3), weathers pale blue (5 PB 7/2); aphanitic, locally fine crystalline; small fossil debris, probably gastropod and brachiopod fragments, intermixed with intraclasts in zones and lenses; forms resistant step-like ledges with thin, irregular bedding	18	513½

31	Limestone, silty, fossiliferous, greenish black (5 G 2/1), weathers grayish orange (10 YR 7/4); aphanitic; contains patches of silt on solution pitted surface; scattered fossils include gastropod, cephalopod, and brachiopod hash; single ledge-former with thin, wavy bedding	1½	515
30	Limestone, silty, medium dark gray (N 4), weathering pale blue (5 PB 7/2); aphanitic, locally very fine crystalline; grayish orange (10 YR 7/4) silt intercalations common; minor gastropod, brachiopod, and cephalopod fragments; forms 1- to 3-foot step-like ledges with thin, wavy bedding	14	529
29	Limestone, silty, fossiliferous, mottled medium dark gray (N 4) to light olive gray (5 Y 5/2), weathering dark yellowish orange (10 YR 6/6); aphanitic, locally fine crystalline; contains silt intercalations in irregular patches; abundant gastropods, brachiopods, cephalopods; forms single ledge with thin, wavy bedding	2½	531½
28	Limestone, fossiliferous, intraclastic, medium dark gray (N 3), weathers pale blue (5 PB 7/2); aphanitic, locally recrystallized to coarse grained where intraclastic; fossils include brachiopods, gastropods, and silicified cephalopod siphuncles; stromatolites abundant especially near base, up to one-foot thick; forms thick, massive ledge where stromatolitic, locally thin and wavy bedded	43	574½
Mud Springs Mountain Formation			
27	Limestone, cherty, fossiliferous, locally intraclastic, medium dark gray (N 4.5), weathers medium light gray (N 6); aphanitic, locally fine crystalline; contains abundant hackly chert intercalations weathering in strong relief; fossils include abundant Bridgeites gastropods, brachiopods, and stromatolitic zones up to 4 feet thick; forms steep, resistant ledge, with thin, irregular bedding	20½	595

Transition zone

26	Limestone, silty, fossiliferous, medium dark gray (N 4), weathering medium light gray (N 6); aphanitic, locally fine crystalline; contains grayish orange (10 YR 7/4) silt intercalations weathering in relief; locally intraclastic where fossils - rich; include brachiopod and gastropod hash; forms step-like ledges with thin, irregular bedding	26½	621½

Jose Formation

25	Limestone, oolitic, fossiliferous, dark gray (N 3), weathering medium dark gray (N 4.5), with scattered dark yellowish orange (10 YR 6/6) silt; aphanitic, locally recrystallized; oolites abundant in lenses and stringers with minor sand; abundant small fossil debris, possibly brachiopod, gastropod, and trilobite hash; forms resistant ledge with thin, irregular bedding . . .	4½	626
24	Limestone, silty, intraclastic, dark gray (N 3), weathers light gray (N 6); aphanitic; silt abundant throughout unit; aphanitic intraclasts common, usually associated with small fossil hash in channel fill and lenses; forms thin (2- to 5-inch) nonresistant slabs and plates, with thin, irregular bedding	5	631
23	Limestone, oolitic, fossiliferous, dark gray (N 3), weathering medium dark gray (N 4); fine to medium crystalline, recrystallized; oolites common in lenses and zones, locally with intraclasts; fossil hash abundant but small, possibly gastropod, brachiopod, and trilobite fragments; forms single resistant ledge with thin, wavy bedding	3	634
22	Limestone, silty, oolitic, dark gray (N 3), weathering medium gray (N 5) with grayish orange (10 YR 7/4) silt intercalations; fine crystalline, locally recrystallized to coarse grained where fossil rich; oolites abundant, often associated with intraclastic channel fill; fossil hash common but small		

	(less than ½-inch); nonresistant unit, forms thin slabs and plates with thin, irregular bedding	3½	637½
21	Limestone, oolitic, fossiliferous, dark gray (N 3), weathers medium dark gray (N 4); recrystallized, fine to medium crystalline; oolites abundant in layers and lenses, locally with intraclasts; fossils common but small, possibly gastropods, trilobites (Aulacoparia), and brachiopods; forms single, massive ledge . . .	3	640½
	Victorio Hills Formation		
20	Limestone, silty, moderate brown (5 YR 4/4), weathers dark yellowish orange (10 YR 6/6); aphanitic to fine crystalline; wispy, wavy silt intercalations common, interlayered with scattered fossiliferous lenses; possibly brachiopod and gastropod fragments; forms small ledges with thin, irregular bedding	4	644½
19	Linestone, silty, fossiliferous, medium dark gray (N 4), weathering medium gray (N 5); medium crystalline; recrystallized; wavy, silty intercalations scattered; contains ¼- to ½-inch aphanitic spheres (Girvanella?) intermixed with abundant gastropod and brachiopod fragments; forms thick, step-like ledges with thin, irregular bedding	4½	649
18	Limestone, silty, fossiliferous, medium dark gray (N 4), weathering medium light gray (N 6); silty zones are dark yellowish brown (10 YR 7/2), weathering grayish orange (10 YR 7/4); aphanitic to very fine crystalline; fossil debri includes gastropods, brachiopods, and silicified piloceroid siphuncles, often localized in lenses and pods surrounded by silty limestone; forms single ledge with thin, erratic bedding	1½	650½
17	Limestone, sandy, oolitic, locally fossiliferous, medium dark gray (N 4), weathers medium light gray (N 6); aphanitic, locally fine crystalline; oolites and sand intermixed, especially common near top of unit; abundant silicified piloceroid siphuncles, some gastropod and brachiopod hash in lenses and pods; forms thick resistant ledges, with thin, wavy bedding	11	661½

16	Limestone, silty, oolitic locally, medium dark gray (N 4), weather medium light gray (N 6); aphanitic, locally fine crystalline; silt localized in lenses and pods; oolites scattered throughout unit; sparse fossil debris, including silicified piloceroid siphuncles, gastropods, and brachiopods; forms small (1- to 6-inch) nonresistant layers with thin, irregular bedding	6½	668
15	Limestone, silty, light olive gray (5 Y 5/2), weathers grayish orange (10 YR 7/4); aphanitic to very fine crystalline; silt common, weathering in patches and irregular pods; sparse fossil hash; small ledge with thin, irregular bedding	2½	670½
14	Limestone, silty, locally oolitic, medium gray (N 5), weathers medium light gray (N 6); recrystallized, fine to coarse crystalline; oolites scattered, usually intermixed with intraclasts and fossil debris; abundant brachiopods, trilobites, cephalopods (Mesopiloceras, Capricoceras), and gastropods; forms 1 - to 4-foot ledges with thin, wavy bedding	17½	688
13	Limestone, locally oolitic, medium dark gray (N 4), weathers medium light gray (N 6); aphanitic to fine crystalline; contains variable amounts of wispy, wavy silt intercalations weathering in relief; oolites common in layers and lenses with small (less than ½-inch) fossil fragments; forms step-like ledges with thin, irregular bedding . . .	5½	693½
12	Dolomitic limestone, medium gray (N 4), weathering pale blue (5 PB 7/2); aphanitic; contains scattered irregular silt intercalations; sparse small fossil debris with some burrow casts on bedding planes; forms single, massive ledge	5	698½
11	Dolomite, silty, mottled pale red (5 R 6/2) to grayish red (5 R 4/2), weathering grayish orange (10 YR 7/4) to light brown (5 YR 6/4); very fine crystalline; variable amounts of wispy, wavy silt intercalations; sparse fossil debris, occasional silicified piloceroid siphuncles; forms single resistant ledge with thin, irregular bedding	5	703½

10	Dolomitic limestone, silty, medium gray (N 5), weathers medium light gray (N 6); aphanitic to very fine crystalline; silt abundant as wispy, wavy intercalations weathering in relief on solution pitted surface; forms small step-like ledges with thin to very thin wavy bedding	9½	713
9	Calcareous dolomite, silty, mottled dusky red (5 R 3/4) to medium light gray (N 6), weathering grayish orange (10 YR 7/4); very fine to fine crystalline; variable amounts of wispy silt present throughout unit; forms step-like ledges with thin to very thin wavy bedding	9	722
8	Dolomitic limestone, silty, light olive gray (5 Y 6/1), weathers light bluish gray (5 B 7/1); aphanitic to fine crystalline, locally coarse; wispy, wavy silt intercalations common; rare gastropod and brachiopod fragments; forms single resistant ledge with thin to very thin bedding	8½	730½
Cooks Formation			
7	Calcareous dolomite, medium light gray (N 6), weathering grayish orange; rare sand grains scattered near top of unit; forms 2- to 5-foot thick ledges with thin, irregular bedding	13	743½
6	Calcareous dolomite, medium gray (N 5) to medium light gray (N 6), weathers pale yellowish brown; medium to coarse crystalline; transition zone between dense, dolomitic layers near base, and friable, punky limestone at the top; dark (Girvanella) algal spheres scattered near base of unit; forms small ledges, locally platy, with faint wavy bedding	47	790½
Big Hatchet Formation			
5	Dolomite, medium gray (N 5), weathers pale yellowish brown (10 YR 6/2); fine to medium crystalline; contains lenses and layers of spherical to oval Girvanella algal structures; forms steep cliff with thick ledges; bedding obscured	74	864½

Sierrite Formation

4	Dolomite, medium dark gray (N 4), weathers pale yellowish brown (10 YR 5/2); medium crystalline; contains ½- to 1-foot thick lenses and layers of Girvanella algal structures; a dense, homogeneous dolomite forming step-like ledges with faint thin bedding	21½	886
3	Dolomite, sandy, medium light gray (N 6), weathering pale yellowish brown (10 YR 6/2); medium crystalline; contains poorly sorted subangular sand concentrated in lenses and layers; forms small ledges, with thin to medium bedding indicated by sand layers	26	912
2	Dolomite, silty, medium dark gray (N 4), weathering medium gray (N 5); medium crystalline; silt scattered throughout unit; basal contact marked by last interbedded sandstone bed; forms ½- to 2-foot thick ledges with no apparent bedding	42	954
1	Interbedded dolomite and sandy dolomite, sandy layers grayish orange pink (10 YR 8/2), weathering light brown (5 YR 6/4), while dolomite is medium gray (N 5), weathering brownish gray (5 YR 5/1) fine to medium crystalline; transition zone between 1- to 2-foot thick Bliss sandy dolomite and ½-foot thick nonresistant El Paso dolomite; amount of dolomite increases upsection, while sandy layers decrease	11	965
	Total El Paso Group		965

Bliss Sandstone -- Fine to coarse grained sandstone overlying Precambrian granite; locally glauconitic to hematitic, with cross-bedding and rare fossil debris.

LIST OF REFERENCES

Balk, C. L., 1958, The Capitol Dome section, Florida Mountains. Roswell Geol. Soc., Guidebook, 11th Field Conf., p. 46-52.

Entwistle, L.P., 1944, Maganiferous iron ore deposits near Silver City, New Mexico. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Bull. 1a, 70 p.

Flower, R. H., 1957, Studies of the Actinoceratida. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Mem. 2, 101 p.

_____, 1961, Part I. Montoya and related colonial corals; part II. Organisms attached to Ordovician colonial corals. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Mem. 7, 229 p.

_____, 1964, The nautiloid order Ellesmerocratido (Cephalopoda). New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Mem. 12, 234 p.

_____, 1965, Early Paleozoic of New Mexico. New Mexico Geol. Soc., Guidebook, Sixteenth Field Conf., p. 112-131.

_____, 1968, Some El Paso guide fossils. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Mem. 22, 63 p.

_____, 1975, personal communication.

Folk, R. L., 1968, Petrology of sedimentary rocks. Austin, Texas: Hemphill's Book Store, 170 p.

Griswold, G. B., 1961, Mineral deposits of Luna County, New Mexico. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Bull. 72, 157 p.

Grohskopf, J. G., and E. McCracken, 1949, Insoluble residues of some Paleozoic Formations of Missouri, their preparation, characteristics, and application. State of Missouri, Division of Geological Survey and Water Resources, Report of Investigations, no. 10, 39 p.

Howe, H. J., 1959, Montoya Group stratigraphy (Ordovician) of Trans-Pecos, Texas. Amer. Assoc. Petrol. Geologists Bull., v. 43, p. 2284-2332.

Ireland, H. A., 1947, Terminology for insoluble residues. Amer. Assoc. Petrol. Geologists Bull., v. 31, p. 1479-1490.

Jicha, H. L., Jr., 1954, Geology and mineral deposits of Lake Valley quadrangle, Grant, Luna, and Sierra Counties, New Mexico. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Bull. 37, p. 93.

Kelley, V. C., and C. Silver, 1952, Geology of the Caballo Mountains, Univ. N. Mex., Pub. in Geol., N. 4, 286 p.

Kottlowski, F. E., 1961, Description of deposits. In Griswold, G. B., Mineral deposits of Luna County, New Mexico. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Bull. 72, p. 40-149.

_____, 1963, Paleozoic and Mesozoic strata of southwestern and south-central New Mexico. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Bull. 79, 100 p.

_____, and D. V. LeMone, 1969, Border stratigraphy symposium. New Mexico Inst. Min. and Tech., State Bur. Mines and Mineral Res., Circ. 104, p. 17-25.

Kuellmer, F. J., 1956, Geologic map of the Hillsboro Peak thirty-minute quadrangle. New Mexico Inst. Min. and Tech. , State Bur. Mines and Mineral Res. Geol. map 1.

LeMone, D. V., 1967, Canadian Lower El Paso Group, southern Franklin Mountains, El Paso County, Texas (abs.), First ann. mtg., south-central sec., Geol. Soc. Amer., p. 21.

Lindgren, W., L. C. Graton, and C. H. Gordon, 1910, The ore deposits of New Mexico. U. S. Geol. Surv., Prof. Paper 68, 361 p.

Nelson, L. A., 1940, Paleozoic stratigraphy of the Franklin Mountains, west Texas. Amer. Assoc. Petrol. Geologists Bull., v. 24, p. 157-172.

Pray, L. C., 1953, Upper Ordovician and Silurian stratigraphy of the Sacramento Mountains. Amer. Assoc. Petrol. Geologists Bull., v. 37, p. 1894-1918.

_____, 1958, Stratigraphic section, Montoya Group and Fusselman Formation, Franklin Mountains. West Texas Geol. Soc., Guidebook, 1958 Field Trip, p. 31-40.

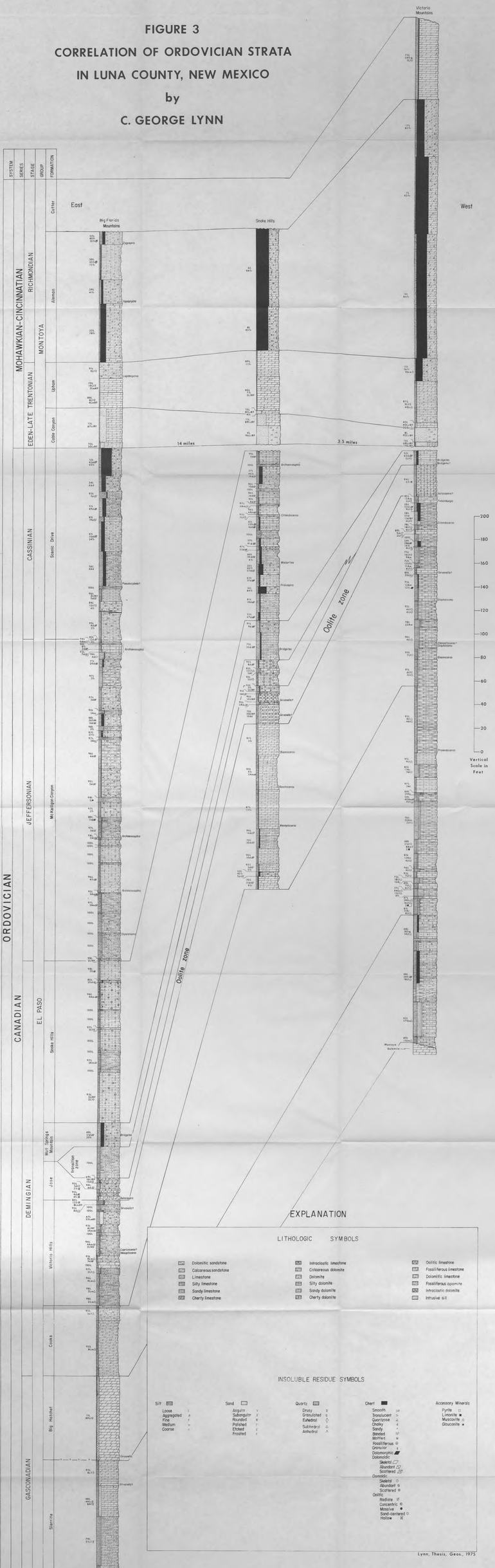
Richardson, G. B., 1904, Report of a reconnaissance in Trans-Pecos Texas. Bull. Texas Univ. Min. Surv., n. 9, p. 29.

Richardson, G. B. , 1908, Paleozoic formations in Trans-Pecos Texas. Amer. Jour. Sci., 4th ser., v. 25, p. 475-479.

_____, 1909, Description of the El Paso Quadrangle, Texas. U. S. Geol. Surv., Folio 166, p. 11.

1 MAP

FIGURE 3
CORRELATION OF ORDOVICIAN STRATA IN LUNA COUNTY, NEW MEXICO
by
C. GEORGE LYNN



Lynn, Thesis, Geos., 1975