STRATIGRAPHY AND MICROFACIES ANALYSIS OF THE HELMS FORMATION (CHESTER), FRANKLIN MOUNTAINS, EL PASO COUNTY, TEXAS, AND BISHOP CAP HILLS, DONA ANA COUNTY, NEW MEXICO

APPROVED:

David V. LeMone

Chairman

N. E. Pingitore Jr.

[illegible]

APPROVED:

[illegible]

Dean of Graduate School

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MOUNTAINS, EL PASO COUNTY, TEXAS,
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by

Robert D. Rinowski, B.A.

Presented to the Faculty of the Graduate School of
The University of Texas at El Paso
in Partial Fulfillment
of the Requirements
for the Degree of

MASTER OF SCIENCE
IN GEOLOGY

THE UNIVERSITY OF TEXAS AT EL PASO
August, 1981

ACKNOWLEDGEMENTS

I extend my greatest appreciation to Dr. David V. LeMone for suggesting the topic of this thesis and for his suggestions and guidance during the writing of it. His energy and sincerity have been inspirational.

Thanks also to Dr. Art Harris for his critical reading of and suggestions for the manuscript of this thesis.

Dr. Nicholas Pingitore provided his usual philosophical criticisms to this work. His criticisms caused some anxiety, but lent polish to the geological interpretations.

Special appreciation is extended to Frank Kottlowski and the New Mexico Bureau of Mines and Mineral Resources for their financial support of this thesis. Without their help, this thesis might not have been possible.

Last, but not least, I would like to thank Dr. Bill Cornell. His help and suggestions during some of the laboratory work are deeply appreciated.

ABSTRACT

Six sections of the Helms Formation (Chester) were measured, examined and sampled in the Franklin Mountains of West Texas and the Bishop Cap Hills of south-central New Mexico. A hypostratotype of the Helms is proposed for the Franklin Mountains and is located near Vinton Canyon.

Throughout the Franklin Mountains the Helms Formation is 52 to 54 meters (170 to 177 feet) thick, consisting of about 90% dark gray, calcareous shale and about 10% limestone. In the Bishop Cap Hills, the Helms is 45 meters (147 feet) thick and consists of about 40% limestone beds.

Fossils are most abundant in the upper one-fourth of the Helms in the Franklin Mountains, and in nearly all of the limestones in the Bishop Cap Hills section. The fauna present include crinoids, bryozoans, brachiopods, gastropods, ostracodes, cephalopods, and foraminifera. A single specimen of the conodont Ozakodina compressa (Rexroad) was collected from a fossiliferous limestone bed in the upper part of the Helms hypostratotype section.

Microscopic examination of 113 thin sections prepared from limestone and shale samples collected from the Helms led to the recognition of 9 microfacies. They are:

Microfacies 1: Microspar with silt, clay, and sparse fossils.

Microfacies 2: Calcareous siltstone.

Microfacies 3: Laminated, bryozoan and crinoid wacke-

stone.

Microfacies 4: Bryozoan, crinoid, and brachiopod calcarenite.

Microfacies 5: Brachiopod calcirudite.

Microfacies 6: Coarse encrinite.

Microfacies 7: Oolitic grainstone.

Microfacies 8: Micritic, intraclastic wackestone.

Microfacies 9: Silty, laminated, calcareous shale.

The Helms Formation was deposited on a gently sloping shelf near the shoreline of the Chesterian sea. Transgressions and regressions of the sea caused the shoreline to fluctuate and accumulate in the form of oolitic and bioclastic sands which are best observed in the Bishop Cap Hills.

Diagenetic alterations in the form of recrystallization is extensive in the Helms. Silicification, dolomite, and pyrite are rarely observed. Compaction features, common in the carbonate sand units, are most often observed at the Bishop Cap Hills.

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CHAPTER I

INTRODUCTION

Purpose and Scope

This study is concerned with the stratigraphy and microfacies analysis of the Helms Formation in the Franklin Mountains, El Paso County, Texas, and in the Bishop Cap Hills, Dona Ana County, New Mexico.

Six stratigraphic sections of the Helms Formation were measured and sampled during the summer and fall of 1980. Five of the six sections were measured in the northern Franklin Mountains: 1) in Avispa Canyon, 2) at the southern rim of Vinton Canyon, 3) in Vinton Canyon, 4) in Hitt Canyon, and 5) at Anthony Gap. The sixth section was measured in the southern part of the Bishop Cap Hills.

Through stratigraphic and microscopic examination of the Helms Formation, depositional environments have been interpreted for the formation within the study area. In addition a regional hypostratotype has been proposed for the Helms Formation near Vinton Canyon in the Franklin Mountains.

This location for the proposed hypostratotype was chosen because of the relatively complete exposure of the formation there, ease of accessibility, and the proximity to type sections of other Paleozoic strata in the Franklin Mountains.

Location and Accessibility

Vinton Canyon is located in the west-central Franklin Mountains between latitudes 31° 57' 30" N and 31° 58' 30" N, and longitudes 106° 30' W and 106° 31' W. This location is 14 miles (22 km) north of El Paso, Texas, and can be reached by exiting U.S. Interstate Highway 10W at the Vinton interchange. Drive east on 0.25 mile (0.4 km) of paved road, then turn to the right on a dirt road leading to the entrance of Vinton Canyon (Figs. 1, 2, and Pl. 1).

Avispa Canyon is located at about 31° 56' 36" N and 106° 30' 31" W in the Franklin Mountains (Pl.1). It can be reached by driving east from the U.S. Interstate Highway 10 on the Trans-Mountain highway. Enter Tom May's Park from this highway staying to the left until a steep, jeep trail is encountered. Avispa Canyon can be entered at the base of the trail.

Anthony Gap is situated at the northern end of the main segment of the Franklin Mountains (Fig. 1). It can be reached by taking the Anthony exit off Interstate 10 to O'Hare road which passes through Anthony Gap.

Hitt Canyon is situated just south of Anthony Gap and can be reached by foot-path across a low saddle near O'Hare road.(Fig. 1, Pl. 1)

The Bishop Cap Hills are 37 miles (60 km) north of El Paso and can be reached from Interstate 10 by driving the dirt access roads leading from the Mesquite exit (Figs. 1, 3, and Pl. 1).

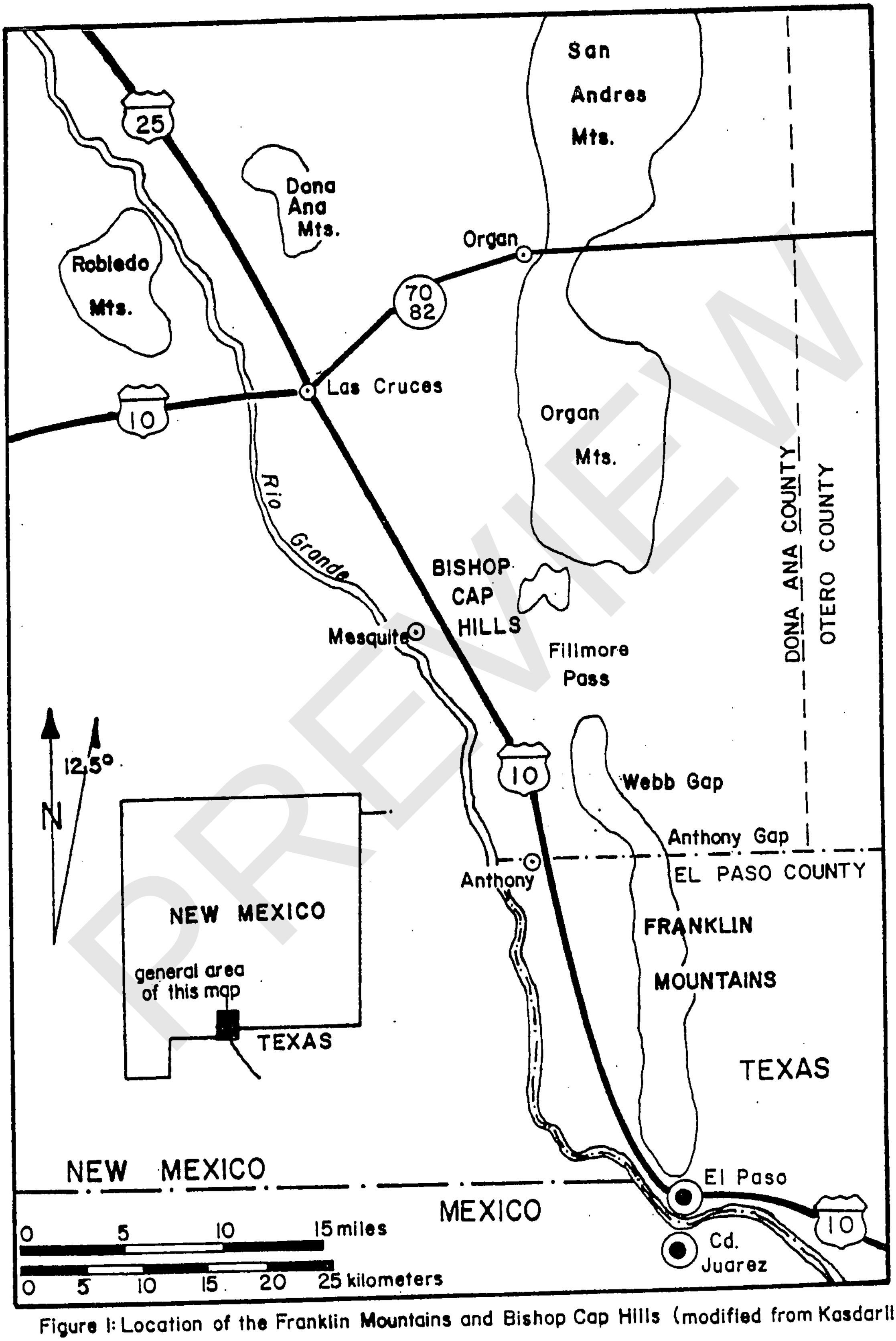

Figure 1: Location of the Franklin Mountains and Bishop Cap Hills (modified from Kasdarli, 1977)

Figure 2: General view of Vinton Canyon.

Figure 3: View of the Bishop Cap Hills.

CHAPTER II

REGIONAL SETTING AND PHYSIOGRAPHY

The Franklin Mountains are a linear, north-south trending, westward tilted fault block range of the southern Basin and Range Province (Harbour, 1972). The range is 23 miles (38 km) long and consists of three distinct segments.

The major segment extends from the central part of the city of El Paso, Texas, to Anthony Gap, just north of the Texas - New Mexico boundary. The second segment is situated between Anthony Gap and Webb Gap; the third segment extends from Webb Gap to Fillmore Pass (Figs. 1 and 4).

The Franklin Mountains are less than 5 miles (8 km) wide, bounded on the east by the Hueco Bolson and on the west by the Mesilla Valley. The eastern and western boundary fault zones were mapped by Lovejoy (1973) (Fig. 4).

Maximum elevation of the Franklin Mountains is 7192 feet (2193 m) at North Franklin Peak. Elevations of the measured sections range between 5000 and 5400 feet (1524 and 1646 meters).

The Bishop Cap Hills lie between the Franklin Mountains and the Organ Mountains in southern Dona Ana County, New Mexico (Fig. 1) The hills are erosional remnants of five north-trending, westward dipping fault blocks (Seager, 1973). They cover an area of 7 square miles (11 sq. km) on the southern rim of the 10 mile (16 km) wide Organ Caldera, dated at 32 million years old (Hawley, 1978). The hills are separated

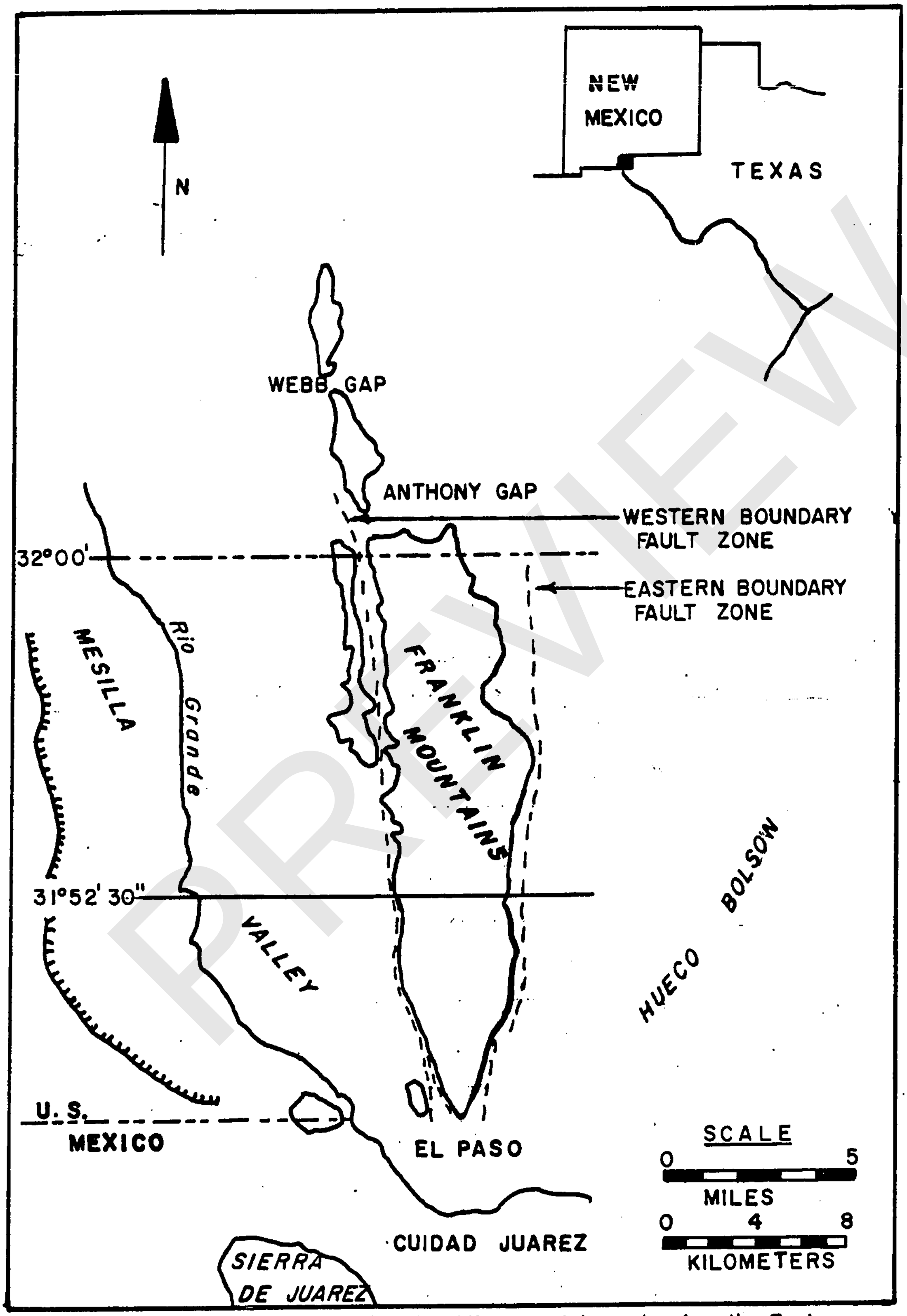

FIGURE 4: Physiographic map of the Franklin Mountains showing the Eastern and Western Boundary Fault Zones (After Lovejoy, 1976).

from the Franklin Mountains by Fillmore Pass and from the Organ Mountains by a wide alluvial fan (Seager, 1973).

Geologic History

In the area of the Franklin Mountains, folding and uplift occurred during Precambrian time. Subsequent uplift and subsidence throughout the Paleozoic caused shallow epeiric seas to slowly transgress and regress across the region (Harbour, 1972).

Tectonic deformation was "especially gentle" in Cambrian through Mississippian time (Harbour, 1972, p. 66). At this time a pattern of gentle uplift in the north and subsidence in the south was established (Harbour, 1972, p. 66), and may have signaled the development of the Orogrande Basin referred to by Kottlowski (1962).

The Franklin Mountains were uplifted by Cenozoic deformation forces. Harbour (1972) attributes the uplift and structural features of the Franklin Mountains to both tensional and compressional forces, with the major structural features, and subsequent minor structural features occurring in Early Tertiary time.

STRATIGRAPHY

General

Exposed strata in the Franklin Mountains, Bishop Cap Hills, and surrounding valleys range from Precambrian to Holocene in age, with a total thickness of 22,000 feet (6707 m)

(Harbour, 1972). The Precambrian rocks consist of about 5000 feet (1524 m) of volcanic and metamorphic rocks intruded by granite (Harbour, 1972).

The major portion of the Franklin Mountains is composed of Paleozoic carbonate and clastic sedimentary rocks totaling about 8000 feet (2440 m) in thickness (Nelson, 1940). In the Bishop Cap Hills, about 2500 feet (762 m) of Ordovician through Pennsylvanian rocks are exposed (Kramer, 1970).

The western slope of the Franklin Mountains is composed of Silurian to Lower Permian rocks to which the following discussion will be confined (Table I).

SILURIAN SYSTEM

Fusselman Formation

Silurian rocks in the study area are represented by the Fusselman Formation, named for Fusselman Canyon in the east-central Franklin Mountains by Richardson (1908). The type section was established by Pray (1958). He described the formation north of Fusselman Canyon.

The type section is 313 feet (95 m) thick and consists of massive, coarse-grained, sucrosic dolomite. The dolomite beds contain chert nodules and some brown, siliceous streaks. Maximum thickness of the Fusselman Formation is 640 feet (195 meters), recorded at North Anthony's Nose in the Franklin Mountains by Harbour (1972). In the Bishop Cap Hills, the Fusselman Formation is 310 feet (94 m) thick (Kramer, 1970).

The formation is assigned to Middle Silurian age on the

<table>
<tr><th>TIME UNITS</th><th>TIME ROCK UNITS</th><th colspan="2">ROCK UNITS</th></tr>
<tr><td rowspan="3">PERMIAN</td><td rowspan="3">WOLFCAMPIAN</td><td>ALACRAN MT. [2]</td><td rowspan="3">HUECO GROUP</td></tr>
<tr><td>CERRO ALTO [2]</td></tr>
<tr><td>HUECO CANYON [2]</td></tr>
<tr><td rowspan="6">PENNSYLVANIAN</td><td>VIRGILIAN</td><td rowspan="2" colspan="2">PANTHER SEEP [2]</td></tr>
<tr><td>MISSOURIAN</td></tr>
<tr><td rowspan="2">DES MOINESIAN</td><td>BISHOPS CAP [2]</td><td rowspan="4">MAGDALENA GROUP</td></tr>
<tr><td>BERINO</td></tr>
<tr><td>ATOKAN</td><td rowspan="2">LA TUNA</td></tr>
<tr><td>MORROWAN</td></tr>
<tr><td rowspan="5">MISSISSIPPIAN</td><td>CHESTERIAN</td><td colspan="2">HELMS</td></tr>
<tr><td rowspan="2">MERAMECIAN</td><td colspan="2">RANCHERIA</td></tr>
<tr><td colspan="2">LAS CRUCES [2?]</td></tr>
<tr><td>OSAGIAN</td><td colspan="2">LAKE VALLEY [1]</td></tr>
<tr><td>KINDERHOOKIAN</td><td colspan="2">CABALLERO [1]</td></tr>
<tr><td rowspan="2">DEVONIAN</td><td>UPPER</td><td colspan="2">PERCHA</td></tr>
<tr><td>MIDDLE</td><td colspan="2">CANUTILLO</td></tr>
<tr><td>SILURIAN</td><td>NIAGARAN</td><td colspan="2">FUSSELMAN</td></tr>
</table>

TABLE I: GENERAL STRATIGRAPHY OF THE WEST SLOPE OF THE FRANKLIN MOUNTAINS AND BISHOP CAP HILLS.

1 - MISSING IN THE FRANKLIN MOUNTAINS.

2 - MISSING IN THE BISHOP CAP HILLS.

(ADAPTED FROM LEMONE, 1969)

basis of contained brachiopods. The possibility of Lower Silurian age rocks being present cannot be ruled out for the Fusselman, as fossils of that age were found in the formation in the Sacramento Mountains by Pray (1954).

The Fusselman Formation contrasts with the overlying Late Paleozoic rock formations by the lack of terrigenous sediment present. Because of its wide distribution and marine fossils, the Fusselman Formation has been interpreted as being "deposited far offshore in a shallow sea" (Harbour, 1972, p. 33).

DEVONIAN SYSTEM

The Devonian System in the region marks the change from carbonate deposition to a more clastic sequence (Kottlowski, 1963). After tilting and erosion of the Fusselman Formation, deposition of Devonian strata began in late Middle Devonian time (Harbour, 1972).

The presence of Devonian rocks in the Franklin Mountains was first reported by King and King (1929). Nelson (1940) assigned all the Devonian rocks in the area to the Canutillo Formation. Laudon and Bowsher (1949) restricted the name Canutillo to the lower portion of Nelson's sequence.

Canutillo Formation

According to Rosado (1970), the Canutillo Formation is 133 feet (40 m) thick in the Franklin Mountains. He separated the formation into four distinct units. The stratotype of