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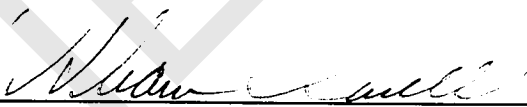
PREVIEW

**DEPOSITIONAL HISTORY AND SEDIMENTARY PETROLOGY OF THE
HUETAMO SEQUENCE, SOUTHWESTERN MEXICO**

MARTIN GUERRERO-SUASTEGUI

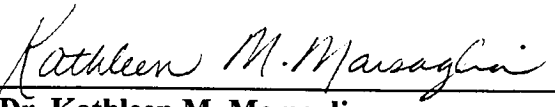
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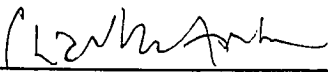
APPROVED:


Dr. William C. Cornell, Chair


Dr. Richard P. Langford


Dr. Arthur H. Harris


Dr. Kathleen M. Marsaglia


**Associate Vice President
for Graduate Studies**

DEDICATION

This thesis is dedicated to the people of Mexico who paid me a scholarship via CONACYT to be part of the 0.2% of Mexican students studying a degree outside of Mexico.

My mother, Antonia Suastegui, who is a continuous source of motivation.

Paula and Sandino who support me all the time.

**DEPOSITIONAL HISTORY AND SEDIMENTARY PETROLOGY OF
THE HUETAMO SEQUENCE, SOUTHWESTERN MEXICO.**

by

MARTIN GUERRERO-SUASTEGUI

THESIS

**Presented to the Faculty of the Graduate School of
University of Texas at El Paso**

in partial fulfillment

of the requirements

for the degree of

MASTER OF SCIENCE

Department of Geological Sciences

THE UNIVERSITY OF TEXAS AT EL PASO

JULY 1997

ACKNOWLEDGMENTS

I would like to thank Consejo Nacional de Ciencia y Tecnología (CONACYT) for financial support to do this work. Special thanks to Dr. Richard N. Hiscott who taught me to recognize and work in the field with this type of sequence, as well as for his enthusiastic support during two field periods in the area and all the time that he spent with me.

I would like to thank to Joel Ramirez and Oscar Talavera, coauthors in this effort, for their valuable comments and discussions about the geological problems in southwestern Mexico and friendship. Special thanks go to Joel who has helped me to understand the Geology in my study field and to Oscar who helped me to understand the magmatic evolution of the Huetamo area. Maria Fernanda Campa taught me much about geology with her articles, discussions, and long talks. Thanks to Elena Centeno and José Luis García for their discussions about the geology of the Guerrero Terrane.

My gratitude to my thesis committee: Dr. William Cornell, chair, who adopted and helped me during the worse time of the thesis; Dr. Kathleen Marsaglia, who helped and supported me constantly. Discussions and long conversations with her opened my mind to some problems about the sandstone petrography of the Huetamo area. Dr. Richard Langford and Dr. Arthur Harris gave valuable comments and academic support during the thesis.

Dr. LeMone for his teaching during my graduate studies. I wish that all geologists were like him. I am really grateful to Dr. Kenneth Clark for his help and support.

Ruben and Mayra helped helping me with the field work and taught me to be a "teacher".

Maru, Garibay, and Dr. B. Buitrón identified the fossils and taught me how recognized different kinds of fossils and their stratigraphic importance.

Thanks to my colleagues Juan Carlos, Rudy, Claudio, Carlos, and Vilma for their encouragement and moral support through these years and bad times.

Kelly helped me to stain the thin sections.

Last, but not least, I would like to thank the teachers and all the students of the ErCiTi for their moral and emotional support. This thesis is their thesis, too.

Thesis submitted to committee on May 15, 1997.

ABSTRACT

The study area is located in southwestern Mexico near Huetamo area within the states of Michoacán and Guerrero. The western margin of Mexico consists of Late Jurassic to Early Cretaceous arc-related sequences known as the Guerrero Terrane. The Guerrero Terrane is divided in southwestern Mexico into three distinctive subterranees characterized by their own stratigraphic record, structural evolution, and geochemical features: the Teloloapan subterrane, the Arcelia-Palmar Chico subterrane, and the Zihuatanejo-Huetamo subterrane. The study area is located in the Zihuatanejo-Huetamo subterrane. The Early Cretaceous formations of the Huetamo sequence are coarse to fine clastic rocks, volcanoclastic, and scarce volcanic rocks (Angao and San Lucas formations), and limestone of the Comburindio Formation. The Angao and Lower San Lucas formation contain abundant conglomerates. These conglomerates contain volcanic, sedimentary, and metamorphic clasts. Conglomerate petrography suggests multiple sources for these clasts. These sources include basement rocks, Upper Paleozoic shallow marine deposits, continental, and oceanic volcanic units. Sandstones of the same units show different categories of sandstone and volcanoclastic rocks. Lithofacies analysis of the clastic and limestone rocks of the Angao, San Lucas, and Comburindio formations suggests that the Huetamo sequence is an apron deposit close to a volcanic arc that includes coastal and platform environments.

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PREVIEW

CHAPTER 1. INTRODUCTION.

1.1. Purpose and objectives.

The study area is located in southern Mexico near Huetamo area within the states of Michoacán and Guerrero. Rocks exposed in this area are essentially composed of clastic and limestone rocks of Early Cretaceous age. Previous workers have proposed that this sequence was deposited in an intra-arc basin setting.

The Huetamo area was chosen to document the sedimentary evolution of this region because it contains a sedimentary sequence neither metamorphosed nor highly deformed. Moreover, the rocks record temporal and spatial variation during the petrographic evolution of a Mesozoic arc-related basin in southwestern Mexico.

The purpose of this research is to: 1) provide detailed stratigraphic description of the clastic Angao and San Lucas formations, as well as of the limestones of the Comburindio Formation; 2) describe the petrologic evolution of the clastic formations; and 3) document the sedimentological history of the area using lithofacies associations and depositional features of the units.

Previously published and unpublished geologic maps (Pantoja, 1959; Campa, 1977; Campa and Ramirez, 1979) of the area were integrated at scale of 1: 50,000. From the composite map, it was possible to identify promising areas for detailed study of the strata and to identify controversial regions needing additional study.

Most field work was done on the San Lucas Anticline where six detailed stratigraphic-sedimentologic sections were measured, described, and sampled. Three additional sections were measured on the Angao and Mal Paso synclines. These sections helped to document the stratigraphic relationship for each formation and the

sedimentary evolution of the Huetamo region.

Samples of clastic and volcanoclastic rocks were collected from the Angao and San Lucas formations for detailed petrographic descriptions in order to characterize the petrologic evolution of both units. Limestone samples were collected to supplement the field description of lithofacies and interpretation of the depositional environments of the Comburindio formation.

Results of this research are presented in five chapters. Chapter one includes background information on the Huetamo area in southwestern Mexico. Chapter two describes the stratigraphy of the area and gives detailed lithostratigraphic descriptions of the three formations studied. The main contribution of this chapter is the redefinition of the Angao Formation. Chapter three describes the petrography of the sandstones, volcanoclastics, and conglomerates of the Angao and San Lucas formations. The petrographic results were used to document the similarities and differences between the two clastic formations. Chapter four documents the lithofacies present in the area. It also describes the sedimentary structures of each lithofacies that further document the depositional environments of the Huetamo area. Finally, in chapter five, a summary and conclusions of the research are presented. Although each chapter discusses the results obtained, chapter five integrates all the data into a whole and summarizes the geological evolution of the Huetamo area and its role in the evolution of the Pacific margin of Mexico.

1.2. Location and access of the study area.

The study area is included in the Huetamo and Coyuca de Catalán topographic maps (scale 1:50 000), 100° 55' to 100° 45' W, and 18° 45' to 19° 32' N (figure 1). It includes 680 km² but the research was conducted in detail in approximately 400 km².

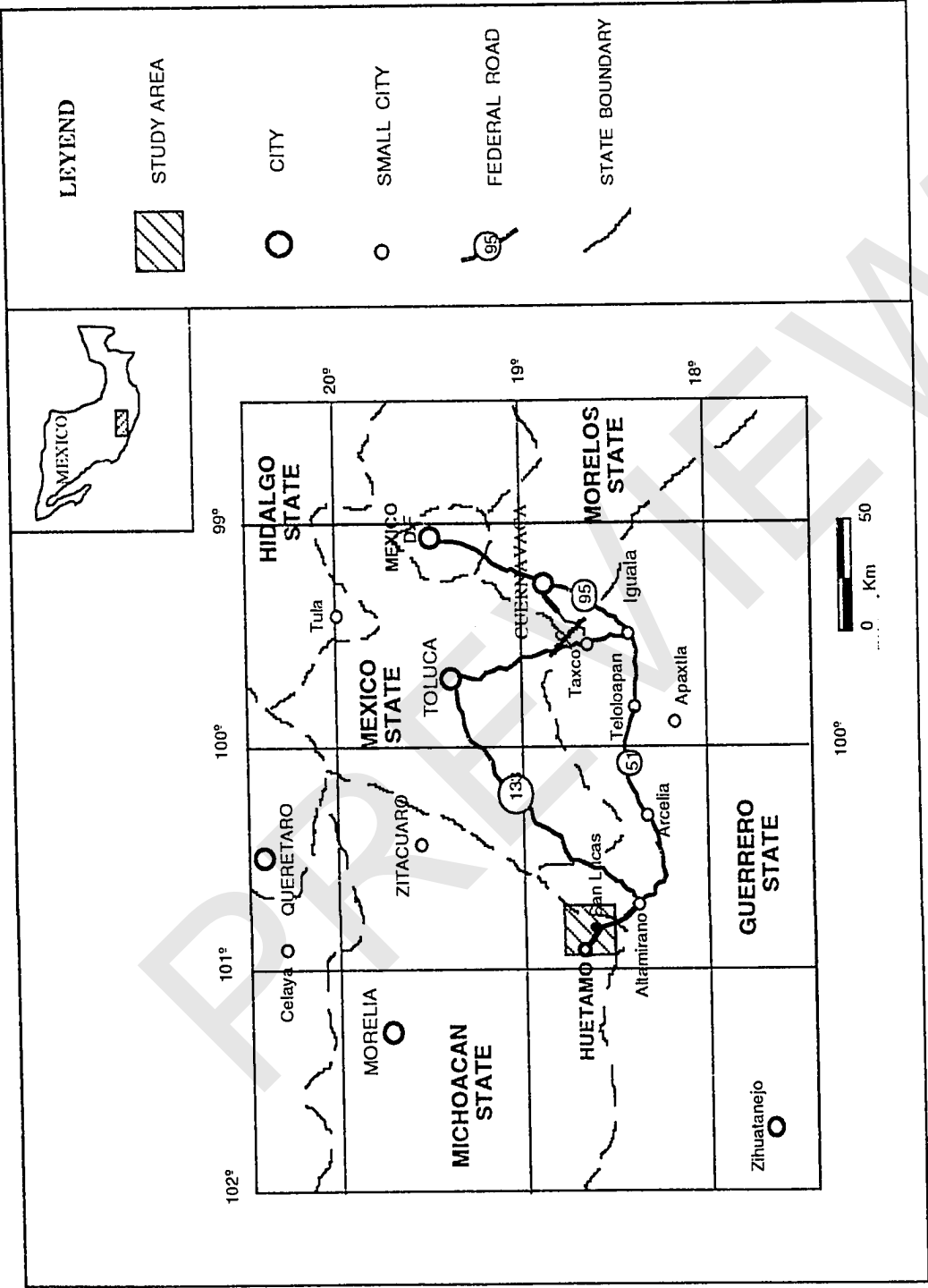


Figure 1. Location of the study area.

The Huetamo area is known as the "Tierra Caliente" region and is located in the southeastern corner of Michoacán and the northwestern part of Guerrero.

Access to the study area is by two federal roads, highway 51 that links Iguala with Ciudad Altamirano and Huetamo, and highway 133 that connects Toluca with Ciudad Altamirano (figure 1). Several small roads interconnect the area. The main towns of the region are Huetamo and San Lucas, Michoacán, and Ciudad Altamirano, Guerrero.

1.3. Previous work.

According to Campa and Ramirez (1979), the earliest published geologic research in the Huetamo area was a reconnaissance of the Placeres del Oro mine (Aguilera et al., 1898). Later, Hall (1903) published a regional map that covers the area and includes the main structural feature of the Huetamo area.

Nevertheless, the first stratigraphic study was done by Pantoja (1959), who formally established the Huetamo-San Lucas stratigraphy. He differentiated four Mesozoic formations. In ascending order these are: Angao, San Lucas, Morelos, and Mal Paso formations, of Kimmeridgian to Maestrichtian age (table 1).

Salazar (1975) redefined Pantoja's stratigraphy and added new stratigraphic data about the Mesozoic sequences. The study illustrates the transitional relationship between the Aptian-Albian formations (San Lucas and Comburindio formations) and regrouped the clastic and limestone units in the San Lucas Group (table 1).

Campa (1977) and Campa and Ramirez (1979) studied the geology of the states of Guerrero and Michoacán. They described the volcanic and volcanoclastic sediments in the Angao and San Lucas formations, confirmed the interfingering of the thick siliciclastic sequence of the San Lucas Formation with the Aptian-Albian limestones, and documented Laramide deformation of the redefined Upper Cretaceous Cutzamala

Table 1. Stratigraphic Correlation of the Huehameo area and proposed in this study.

AGE		Pantoja (1959)	Salazar (1975)	Campa (1977)	Pantoja (1990)	Johnson et al. (1991)	This study
Cretaceous	Cenozoic						
Jurassic							
Triassic							
Paleozoic							

Formation (red beds).

Recently, Pantoja (1990) and Johnson et al. (1991) again redefined the stratigraphy, without modifying the Late Jurassic-Early Cretaceous age (table 1). They and other authors (García and Talavera, 1993; Centeno, 1994) have proposed that the metamorphic rocks of the Placeres del Oro-Pinzán Morado area, located to the south of the study region, are the basement of the Huetamo sequence. Stratigraphic position suggests that these metamorphic rocks range from Paleozoic to Mesozoic in age. Pasquare et al. (1995) also postulated that the Middle Jurassic metamorphic rocks of the Tzitzio area, located to the north of the region, could be the basement of the region.

Several paleontologic studies of the Huetamo sequence have been done using different groups of fossils, such as orbitolinids (Meza, 1980; Schroeder and Chercii, 1993; Pantoja et al., 1994), planktonic foraminifera (Martínez and Garduño, 1978), nerineids (Buitrón and Rivera, 1985; Buitrón et al., 1991; Buitrón, 1993), rudists (Alencaster and Pantoja, 1992 and 1993; Pantoja et al., 1993; Pantoja et al., 1994), and ammonites (Gómez et al. 1994).

Few sedimentological studies have been done in the region. De Cserna et al. (1978) presented a regional correlation and lithofacies analysis in Guerrero and Michoacán, including the Huetamo region. It shows the chronology and sedimentological evolution of the area and also proposes a paleogeographic reconstruction for the region. Johnson et al. (1991) described, in a general way, turbiditic and debris flow deposits.

1.4. Regional and Local Geologic Setting.

The Mexican Pacific margin has a complex geologic history. It is now thought that Mexico, as the southward extension of the Cordilleran system of western North America, was built from multiple accretions of suspect terranes of continental and/or oceanic affinity during the Mesozoic and Cenozoic (Campa and Coney, 1983; Coney, 1983).

Most of the western margin of Mexico consists of Late Jurassic to Early Cretaceous arc-related sequences known as the Guerrero terrane (Campa and Coney, 1983). It is the largest and one of the most complete suites of volcanic-volcaniclastic rocks produced by convergence on the western margin of southern North America during the Mesozoic (figure 2).

The origin and evolution of the Guerrero terrane are still matters of debate and the precise tectonic framework remains to be solved. Several models have been postulated for the volcanic-volcanosedimentary units of this terrane in the Sierra Madre del Sur. These models include: 1) a magmatic arc with eastern subduction (Campa and Ramirez, 1979); 2) an allochthonous oceanic arc with western subduction (Coney, 1983); 3) several arcs whose affinities, position, and age are not completely known (Campa and Coney, 1983); and 4) two magmatic arcs, the Teloloapan-Arcelia arc and Zihuatanejo-Huetamo arc, with associated backarc basins, of different ages (Ramirez et al., 1991).

The Guerrero Terrane is subdivided into three distinctive subterranees in southern Mexico (figure 3): the Teloloapan subterrane, the Arcelia-Palmar Chico subterrane, and the Zihuatanejo-Huetamo subterrane (Campa et al., 1981; Ramirez et al., 1991; Centeno et al., 1993). Each subterrane is characterized by its stratigraphic record, structural evolution, and geochemical features. The Huetamo sequence is



Figure 2. Location of the Guerrero Terrane and other terranes (From Centeno, 1994)

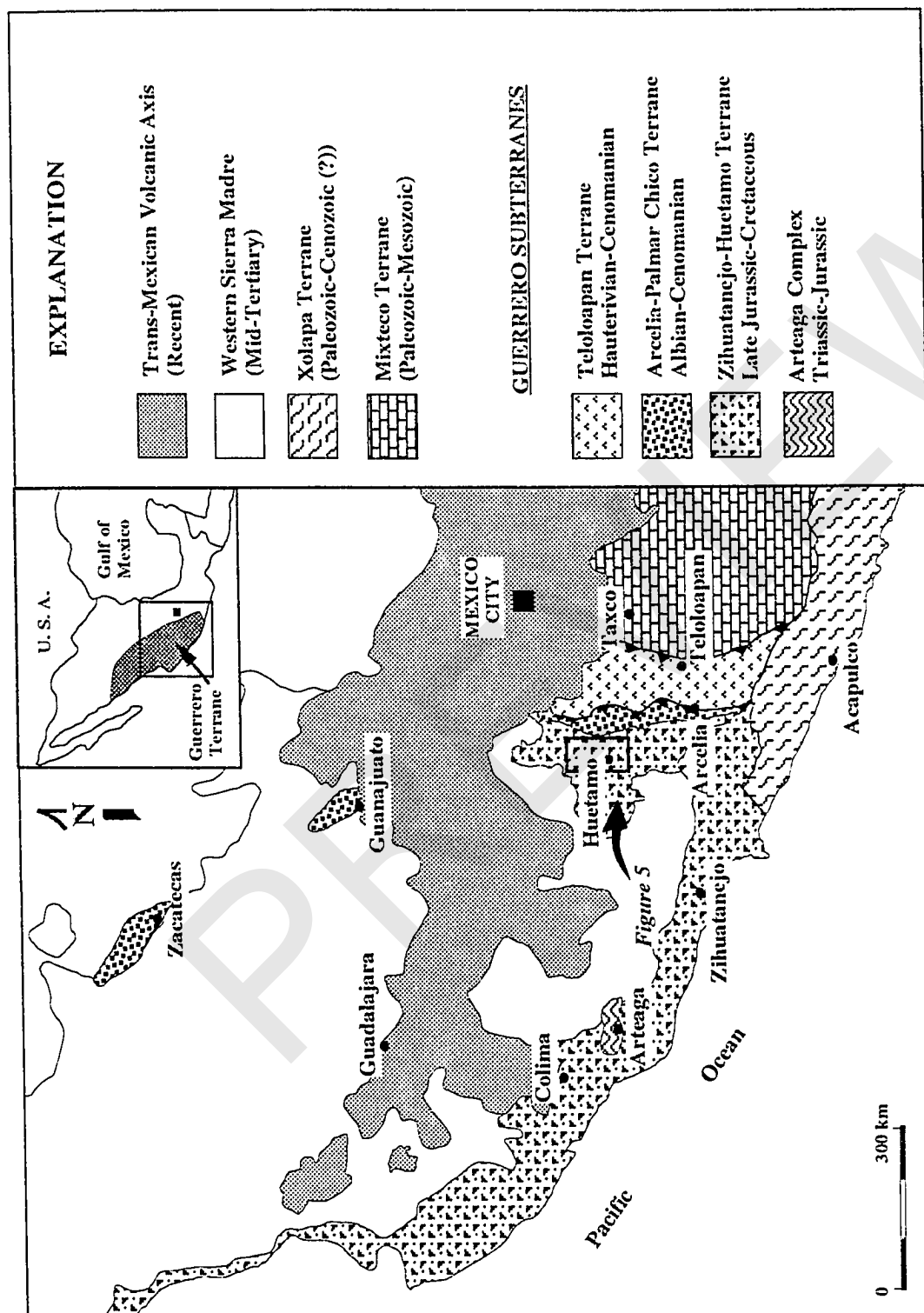


Figure 3. Location of the Guerrero terrane in southern Mexico (From Talavera, 1993)

located to the west of the Arcelia-Palmar Chico subterranean. Its relationships with this subterranean are poorly constrained because contacts are obscured by the Cretaceous and Tertiary red beds of the Cutzamala and Balsas formations. Mid-Tertiary rocks of the western Sierra Madre del Sur mark the western boundary of the Zihuatanejo-Huetamo subterranean.

Several authors have suggested that the metamorphic rocks of the Pinzán Morado-Placeres del Oro, south of the area, and the Caracuaro-Tzitzio region, north of the area, constitute the basement of the Huetamo sequence (Pantoja, 1990; García and Talavera, 1993; Centeno, 1994; Pasquare et al., 1995).

The oldest sedimentary rocks in the study area belong to the Angao Formation of Early Berriasian-Late Valanginian age. They consist of conglomerates interbedded with sandstones, tuffs, and shales, as well as scarce pillow basalt lavas. Resting on the Angao Formation is the San Lucas Formation of Late Valanginian-Late Aptian age. This unit is a thick siliciclastic and turbiditic sequence with abundant ammonites, rudists, and nerineids.

Finally, there are fine-clastic limestones and reefal limestones of the Comburindio Formation (Late Aptian-Albian) interfingering with limestone conglomerates and fine-grained limestones of the Mal Paso Formation which contains shallow marine fossils of Cenomanian age. All the units are covered by thick continental red beds of the Cutzamala Formation (Late Cretaceous).

CHAPTER 2. STRATIGRAPHY.

2.1. Introduction.

Although several studies have been done in the Huetamo area, the nomenclature and age of the lithostratigraphic units are still controversial. Table 1 summarizes the evolution of stratigraphic nomenclature in the Huetamo area. The main purpose of this chapter is to document the stratigraphy of the Lower Cretaceous rocks of the Huetamo area to be used in the sedimentological interpretation of the area, in chapter 4. The Huetamo sequence consists of five formations whose age varies from Early to Late Cretaceous, but I will describe only the Early Cretaceous formations, the Angao Formation which is redefined and dated, San Lucas Formation, and Comburindio Formation, that are significant in my study area.

In general, the Huetamo strata (figure 4) include a thick succession of coarse siliciclastic deposits, volcanoclastic rocks, and scarce lavas, the Angao Formation. It is followed by a monotonous succession of coarse- to medium-grained clastic and volcanoclastic turbidites with abundant fossils, the San Lucas Formation. Next are limestones and fine clastic limestones, Comburindio and Mal Paso formations, with abundant fossils. Red bed deposits of the Cutzamala Formation conclude the sequence. The age documented for these deposits is from Early to Late Cretaceous (table 1). Gradational depositional contacts separate the units.

Metamorphic rocks are not exposed in the area but occur to the south in the Placeres del Oro-Pinzán Morado area, as well as to the north in the Caracuaro-Tzitzio area. As discussed previously, several authors believe that these metamorphic rocks are the basement of the area (Pantoja, 1990; García and Talavera, 1993; Centeno, 1994; Pasquare et al., 1995).

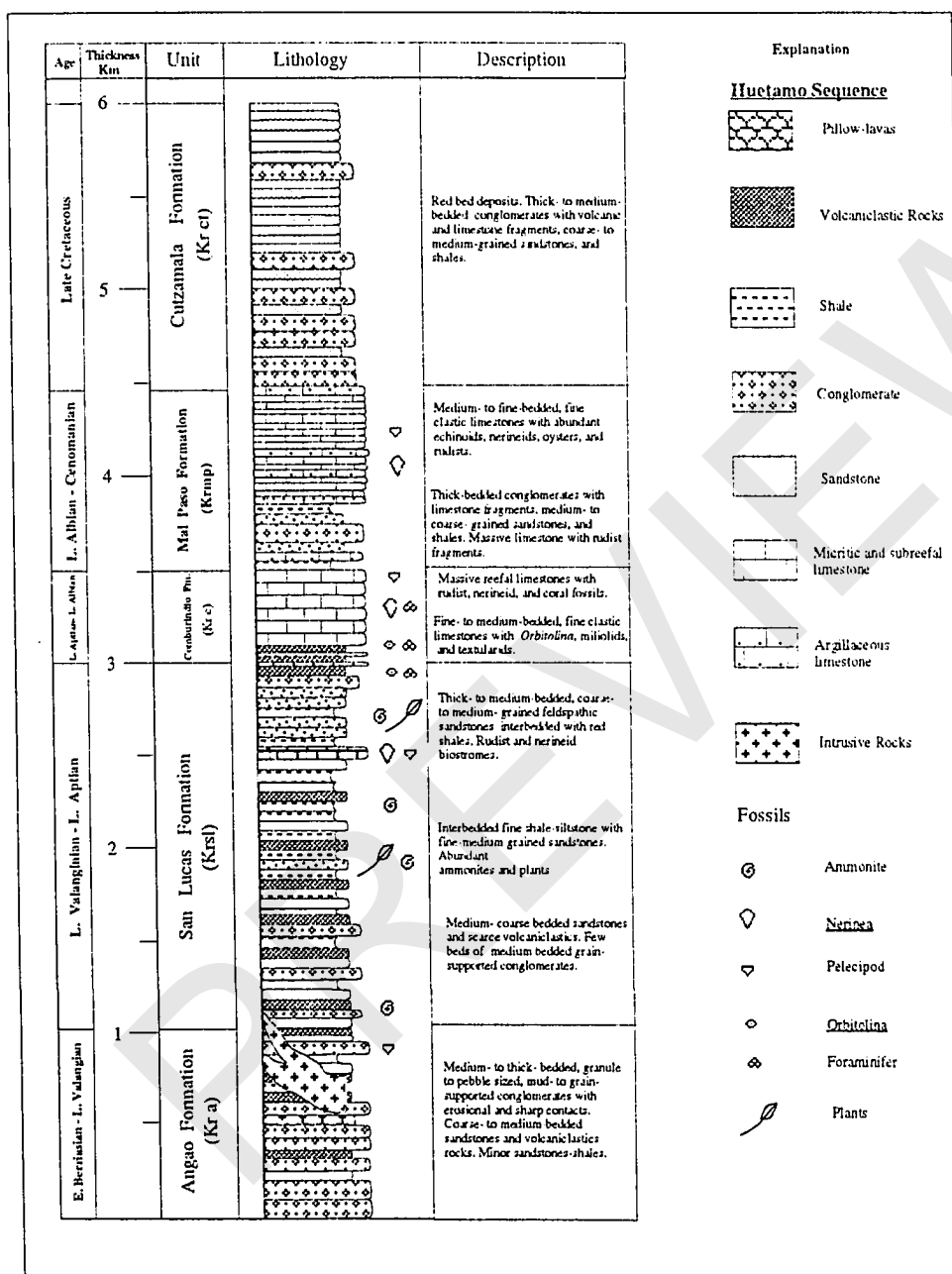


Figure 4. Composite stratigraphic column of the Huetamo area.