GEOLOGY OF THE WIMBERLEY AREA,
HAYS AND COMAL COUNTIES, TEXAS

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GEOLOGY OF THE WIMBERLEY AREA, HAYS AND COMAL COUNTIES, TEXAS

by

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THESIS

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JACOB'S WELL

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ABSTRACT

Cretaceous limestone, marl, and dolomite of Late Aptian to Middle Albian age crop out in the Wimberley area, a 5-minute by 10-minute quadrangle in central Texas situated in the dissected eastern margin of the Edwards Plateau. Formations exposed are the upper part of the Glen Rose, the Walnut, and the lower part of the Edwards. The Glen Rose, which crops out over 90% of the area, is subdivided into 7 informal members defined on mappability on aerial photographs. Six major step faults of the Balcones fault zone transect the area, displacing the strata downward to the southeast about 700 feet. The outstanding geomorphic features are the high relief hills and ridges south of the Blanco River, which are caused by dissection along the Edwards Plateau margin, and the deflections of Cypress Creek and Blanco River where they cross faults.

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INTRODUCTION

The Wimberley area is a quadrangle situated in the Balcones fault zone and in the central Texas outcrop belt of the Cretaceous Comanche Series. This study describes the surface geology of that area. Emphasis is placed on stratigraphy and faulting; other aspects of the geology of the area are briefly discussed. The area is presented in the context of its geographic, climatic, and regional geologic setting. This thesis is one of a continuing series of studies of the Cretaceous System in central Texas being conducted at the University of Texas Department of Geological Sciences under the supervision of Dr. Keith Young.

Location of area: Most of the Wimberley area is in Hays County, Texas, about forty miles southwest of Austin and ten miles northwest of San Marcos (Figure 1). The extreme southwest corner of the area is in adjoining Comal County. The area is defined on the east and west by the meridians 98°05′ and 98°10′ west longitude and on the south and north by the parallels 29°55′ and 30°05′ north latitude. The north-south dimension is about 11.5 miles and the east-west length is 5.0 miles.

The area is centered on the common corner of four U.S. Geological Survey 7½-minute quadrangles, taking in two-ninths of the area of each sheet. These are the Rough Hollow, Driftwood, Wimberley, and Devil's Backbone quadrangles (Plate 1).

The name for the thesis area is taken from the community of Wimberley, the best-known geographic feature of the area. Since it is defined by lines of latitude and longitude, the area is, in a geometric sense, a quadrangle. However, because the name "Wimberley quadrangle" is preempted by the U.S. Geological Survey, 7½-minute quadrangle that takes in the southeast quarter of the area, the thesis quadrangle is referred to as the Wimberley "area."

Accessibility: Access to the Wimberley area is excellent. The quadrangle is easily reached from Austin via U.S. Highway 290 to Dripping Springs and then southward on Texas F.M. 12 toward Wimberley. An alternative approach is through San Marcos on Texas F.M. 12.

Within the area, the most important public roads are F.M. 12, F.M. 32, Purgatory

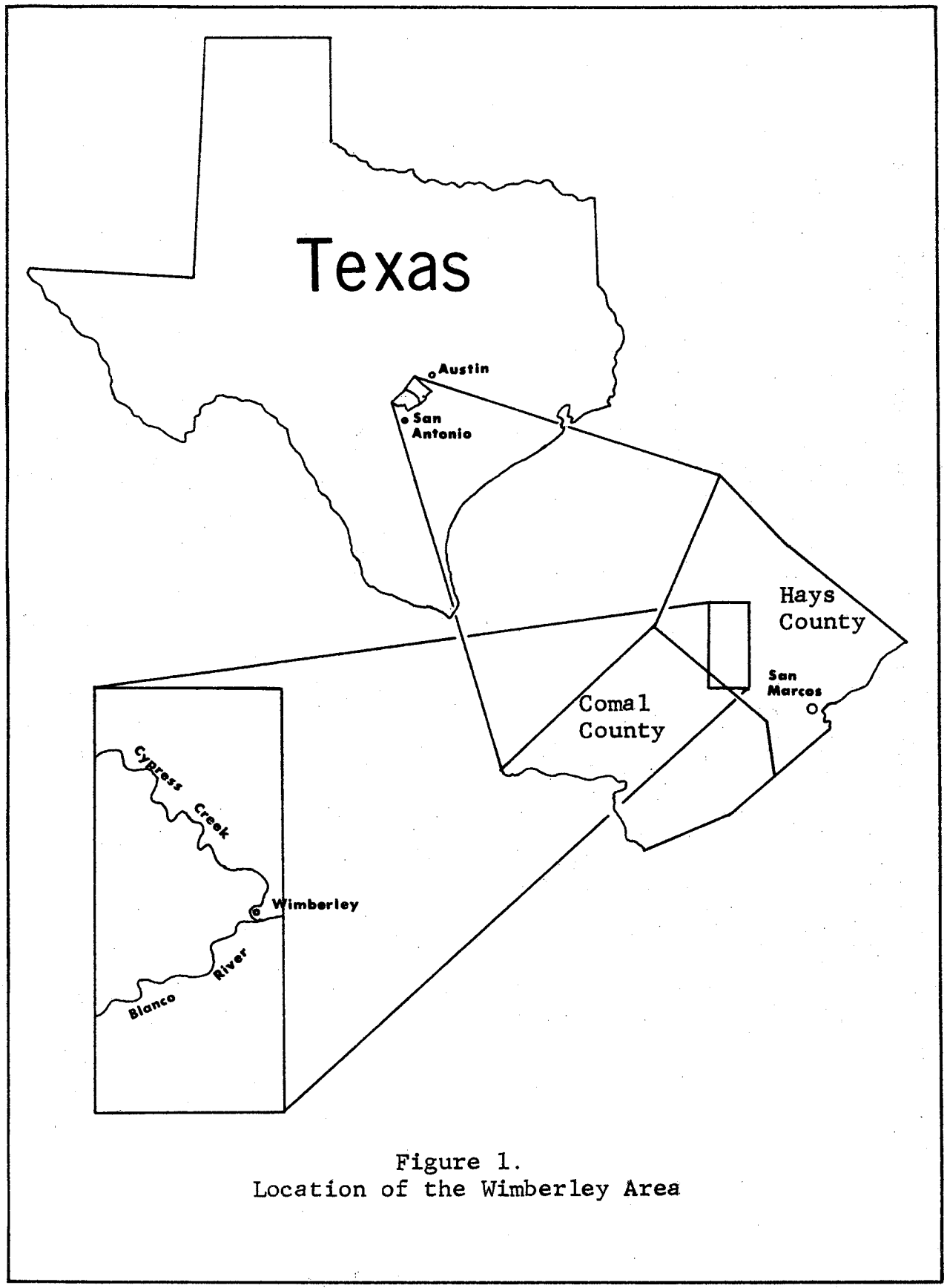

Figure 1.
Location of the Wimberley Area

Road, Cloptin Road, Deer Lake Road, Jacob's Well Road, and Mount Sharp Road. Numerous private roads and trails lead to most points not reachable by public road.

Methods of investigation: After an initial reconnaisance of the thesis area was made, several stratigraphic sections were measured and described. These sections were pieced together and correlated to include all but the uppermost forty-six feet of the stratigraphic interval exposed in the area. Bed thicknesses were measured with a Jacob's staff and Brunton compass clinometer to the nearest one-tenth foot. Rock descriptions were made using a 10X hand lens. Samples were collected from as many beds as possible and were taken to the laboratory, sawed into slabs, etched with dilute hydrochloric acid, and described with the aid of a binocular microscope having up to 60X magnification. Folk's (1962) classification of carbonate rocks was used in all rock descriptions. The synthesized field and lab descriptions appear in the Appendix, and the weathering profiles, lithologies, fossil content, and correlations of the measured sections are shown on Plate 2. The measured section numbers and bed numbers in the Appendix correspond to those of Plate 2.

After the sections were measured and described, the thesis area was mapped on aerial photograph stereo pairs that were flown in 1938. Extensive field checks were made to verify the information mapped on the air photographs. Data from the photographs was transferred with a Saltzmann projector to U.S. Geological Survey 7½-minute topographic quadrangle base maps.

The sections were measured and described in the summer of 1968 and spring of 1969, and the mapping was done during the spring and early summer of 1969. This thesis was written in the late summer of 1969.

Previous investigations: The first significant contributions to the study of Texas geology were made by Ferdinand Römer of the Berlin Academy of Sciences who came to Texas in 1845 and remained for 18 months to determine the suitability of the area for German settlement. During his visit, he made several trips up the canyon of the Guadalupe River, a few miles south of the Wimberley area, to describe the strata and collect fossils. After returning to Germany, he published a series of reports describing the geology and geography of central Texas (1846, 1848, 1849, 1852).

Hill and Vaughan (1898b) described the geology and ground water resources of the Edwards Plateau and Rio Grande Plain. This study included Hays and Comal Counties and they referred to a "canyon well" in the valley of the Blanco River at Wimberley (1898b, p. 271).

Dr. F. L. Whitney supervised several surface studies in Hays and Comal Counties from 1925 to 1935. No reports were written for these studies, but Whitney compiled them into a map which has been edited and published by Dr. Keith Young as a series of 15-minute quadrangles. These maps are available for purchase at the University of Texas Bureau of Economic Geology. The northern half of the Wimberley area is included in the Southeast Blanco sheet and the southern half is on the Hunter sheet.

Marion Whitney (1937) described and named many Glen Rose fossils from the region in and around Comal County and published excerpts from her study (1952a, 1952b).

George (1952) and DeCook (1963) described the geology and ground water resources of Comal and Hays Counties respectively. In these reports, they named some of the faults in the Wimberley area and gave the discharge of Jacob's Well and of the Blanco River at Wimberley.

Stead (1951) studied the Foraminifera of the Glen Rose Formation in Travis, Hays, and Comal Counties. Two of the sections he measured and collected are situated within the Wimberley area.

Lozo and Stricklin (1956) presented stratigraphic notes on some of the classic basal Cretaceous outcrops in central Texas and introduced a tripartite subdivision of the Trinity using the sedimentary cycle concepts of R. T. Hill.

Behrens (1965) closely examined approximately 50 feet of Glen Rose section, 25 feet above and 25 feet below the "*Corbula* bed," in several counties west and southwest of Hays County. His objective was to interpret the depositional environments of the strata.

The U.S. Army Corps of Engineers (1964) made a detailed study of Glen Rose lithology and faulting in the vicinity of the proposed Cloptin Crossing Dam site about two miles upstream from Wimberley on the Blanco River. Included in the report were a

measured and described section of the strata above the bed of the Blanco at the dam site and the lithologic descriptions of 11 cores taken along the proposed dam axis.

Moore has recently studied the stratigraphy of the Walnut Formation (1961) and the Fredericksburg Division (1964) in several central Texas Counties including Hays and Comal Counties. One of the sections for these studies was measured along Purgatory Road about 100 yards south of the southern boundary of the Wimberley area.

Barnes (1952-1967) has mapped several 7½-minute quadrangles northwest of the Wimberley area. The closest of these to the thesis quadrangle is the Yeager Creek quadrangle, which joins the Rough Hollow quadrangle on the northwest.

Dr. Keith Young of the University of Texas Department of Geological Sciences has supervised several masters theses which describe the geology of quadrangles in Hays, Comal, and adjoining counties (Abbott, 1966; Bills, 1957; Cooper, 1964; Davis, 1962; DeCook, 1956; King, 1957; Noyes, 1957). Noyes' thesis area, most of which is immediately southeast of the area described here, includes a small rectangle in its northwest corner that is common to the southeast corner of the Wimberley area. Davis' quadrangle is at the same latitude as the southern half of the Wimberley area but is located 5 miles to the east. The northeast corner of Abbott's map approaches the southwest corner of the Wimberley area.

Acknowledgments: I wish to express my sincere thanks to Mr. Lyman Dawe not only for familiarizing me with Glen Rose lithology and stratigraphy and for acquainting me with effective field methods, but also for providing essential encouragement in the early stages of the field work for this study.

My thanks are also given to the numerous landowners in the thesis area who permitted me to enter their property and to the residents of Wimberley who gave much "logistic" support. Two persons in particular, Mr. P. C. Wenger and Mr. C. B. Smith, deserve thanks for granting me unlimited access to their ranches.

I wish to acknowledge the University of Texas Department of Geological Sciences for purchasing necessary aerial photographs and the Texas Water Development Board for providing the essential topographic maps.

To Dr. P. U. Rodda and Dr. L. S. Land I extend my thanks for serving on my supervising committee.

Finally, I wish to express my sincere gratitude to Dr. Keith Young, the supervising professor for this study, for suggesting the problem, for providing invaluable guidance and suggestions, and for editing the manuscript.

GEOGRAPHY

Regional Geography

The Wimberley area is located on the dissected eastern margin of the Edwards Plateau. The boundary between the plateau and the Gulf Coastal Plain passes about seven miles southeast of the area.

Local Physiography

Drainage: The thesis area contains parts of the drainage basins of four major central Texas rivers; the Blanco, Colorado, Guadalupe, and San Marcos Rivers.

The Blanco River is the most important of the four, draining about 85% of the thesis area. It rises in Kendall County and flows east across Blanco County and then southeast and east across Hays County into the San Marcos River a few miles southeast of San Marcos. Within the bounds of the Wimberley area, the river flows predominantly in an anomolous northeast direction because of fault deflections. Cypress Creek, a perennial stream fed by the spring, Jacob's Well, flows southeast across the area and empties into the Blanco near Wimberley. The gradient of Blanco River is about 8 feet per mile, and the gradient of Cypress Creek is about 24 feet per mile.

The remainder of the thesis area is drained by tributaries to the other three rivers. Sink Creek and Purgatory Creek, both of which are major tributaries to San Marcos River, head in the Wimberley area and drain the southeastern part of the area. The southwestern corner is drained by a small tributary of the Guadalupe River and the northeastern corner is drained by a tributary to Onion Creek, which flows into the Colorado River southeast of Austin.

Landmarks: Several landmarks of the Texas hill country are located in the Wimberley area. The most prominent are Lone Man Mountain, which is situated in the northeast corner of the area, the Devil's Backbone, the sharp, high-relief drainage divide between Blanco and Guadalupe Rivers, and Jacob's Well, one of the largest springs in

Hays County. Other salient features are Lone Woman Mountain, Little Twin Sisters Peaks, and Joe Wimberley Mountain.

Elevations: The highest elevation in the Wimberley area is 1421 feet above sea level at the top of Lone Man Mountain and the lowest is about 805 feet where the Blanco River flows out the eastern margin of the area. A distance of about six miles separates these elevation extremes.

Climate

The climate of the central Texas region, including the Wimberley area, is humid temperate to humid subtropical. The Köppen climate classification symbol for the area is Cfa, which signifies the following: 1. The climate is warm, temperate, and rainy; 2. The average temperature of the coldest month is below 64.4°F (18°C); 3. The average temperature of the hottest month is above 71.6°F (22°C); and 4. There is no distinct dry season (Trewartha, 1954). The average annual rainfall of the Wimberley area, according to an isohyetal map of central Texas published by the U.S. Army Corps of Engineers (1964), is about 34 inches.

Vegetation

The Wimberley area is largely covered with a growth of trees, shrubs, and grasses. Cuyler (1931) has noted the usefulness of vegetation as an indicator of geologic formations of the Texas Cretaceous System. Within the Wimberley area, both the type and the abundance of vegetation are useful in the field and on aerial photographs as an aid to mapping. The most important indicators are the trees and other woody plants. The tree populations on each of the map units will be discussed in the section on stratigraphy.

The taxonomic names of the trees discussed below are taken from Vines (1960). Two species, the live oaks (*Quercus virginiana*) and the junipers (*Juniperus virginiana*), dominate the tree population of the thesis area. The live oaks are most abundant on the more resistant limestone strata, probably because the limestones are fractured and act as water-carrying horizons. The junipers thrive on marl slopes. Live oaks and junipers flourish together in areas of low relief where a soil mantle is developed, but the junipers are commonly removed by ranchers to promote the growth of grass for stock.

Mesquite (*Prosopis juliflora*) prospers on very clayey soils and is usually found on

the alluvial terraces of Blanco River and Cypress Creek. Cypress (*Taxodium distichum*) and sycamore (*Platanus occidentalis*) trees flourish along the banks of Cypress Creek and Blanco River where a plentiful supply of water is available.

Local History

The Tonkawa Indians inhabited the Wimberley area at the time of arrival of the first whites. The Tonkawa were organized into a number of politically and economically independent tribes that were united by a common language and culture. They were semi-nomadic, living primarily on game animals and practicing little agriculture (Suhm, 1960, p. 64). Their numbers dwindled rapidly in the 19th century because of diseases introduced by white settlers and because of attrition by their traditional enemies, the Comanches. The single tribe into which they had coalesced by the late 1800's was removed to an Oklahoma reservation (Suhm, 1960, p. 65) and, aside from a few artifacts, no trace of their presence remains today.

Settlement of the Wimberley area began after 1840. Nearby San Marcos was permanently settled in 1845 (Dobie, 1932). Wimberley traces its beginnings to the fall of 1848, when William Carvin Winters constructed a saw mill at the present site of the community (Dobie, 1932). The village was initially called Glendale, but the name was changed to Wimberley Mills for Pleasant Wimberley, the third owner of the mill. The name was later shortened by the U.S. Post Office Department to its present name of Wimberley (Shawe, 1963).

Economy

The economy of the Wimberley area has been primarily agricultural since the area was settled. With the exception of small parts of upland areas and narrow strips on the alluvial terraces along Cypress Creek and Blanco River, the land is not suitable for farming because of high relief and thin or nonexistent soil. Ranching is, therefore, the predominant source of income, and cattle and goats are the most important livestock. Many ranchers supplement their incomes by leasing their ranches for deer hunting during the season from November to January.

In the vicinity of Wimberley and along Blanco River and Cypress Creek, the economy is changing because of the growing popularity of the area for resorts and

summer homes. This change is manifested in the rising prices of real estate, the breaking up of large ranches into smaller acreages, and the influx of capital from sources outside the area. A dam to be built about two miles upstream from Wimberley on Blanco River has been proposed by the U.S. Army Corps of Engineers (1964). If, or when, it is constructed, the economy of the area will no doubt be enhanced by increased use of the area for recreation.

Two petroleum companies hold most of the oil leases on the property in the area and one of them is engaged in active seismic exploration at the time of this writing.

REGIONAL GEOLOGY

The geology of the Wimberley area is most clearly described and understood if it is viewed in the context of its regional setting. The major regional elements of central Texas will therefore be reviewed here briefly. These elements are the Texas craton, the Ouachita structural belt, the Comanche shelf, the Gulf Coast reef trend, the San Marcos platform, and the Balcones fault zone (Figure 2).

Texas Craton and Ouachita Structural Belt: Two basement features, the Texas craton and the Ouachita structural belt, have been important in the geologic development of the Wimberley area. The Texas craton, the most fundamental element in the basement of Texas, is "a great northwesterly elongated, mostly subsurface, mass of essentially granitic Precambrian plutonic rocks which extends from central Texas into southeastern New Mexico." (Flawn, 1956, p. 25) Rocks taken from the Llano uplift, where the southeast nose of the craton is exposed, have been found by radiochemical dating to be about 1 billion years old (Flawn, 1956).

The southeast margin of the Texas craton is delimited by the Ouachita structural belt, a linear band of faulted and folded Paleozoic rocks which extends at least 1300 miles from east-central Mississippi across Louisiana and Texas and into Mexico for an unknown distance. The belt is named for the Ouachita Mountains where it is well exposed. It was formed late in the Paleozoic Era when orogenic forces compressed the Paleozoic sedimentary rocks of the Ouachita geosyncline against the Texas craton, which acted as a buttressing foreland, and deformed them into complex folds and faults. Flawn

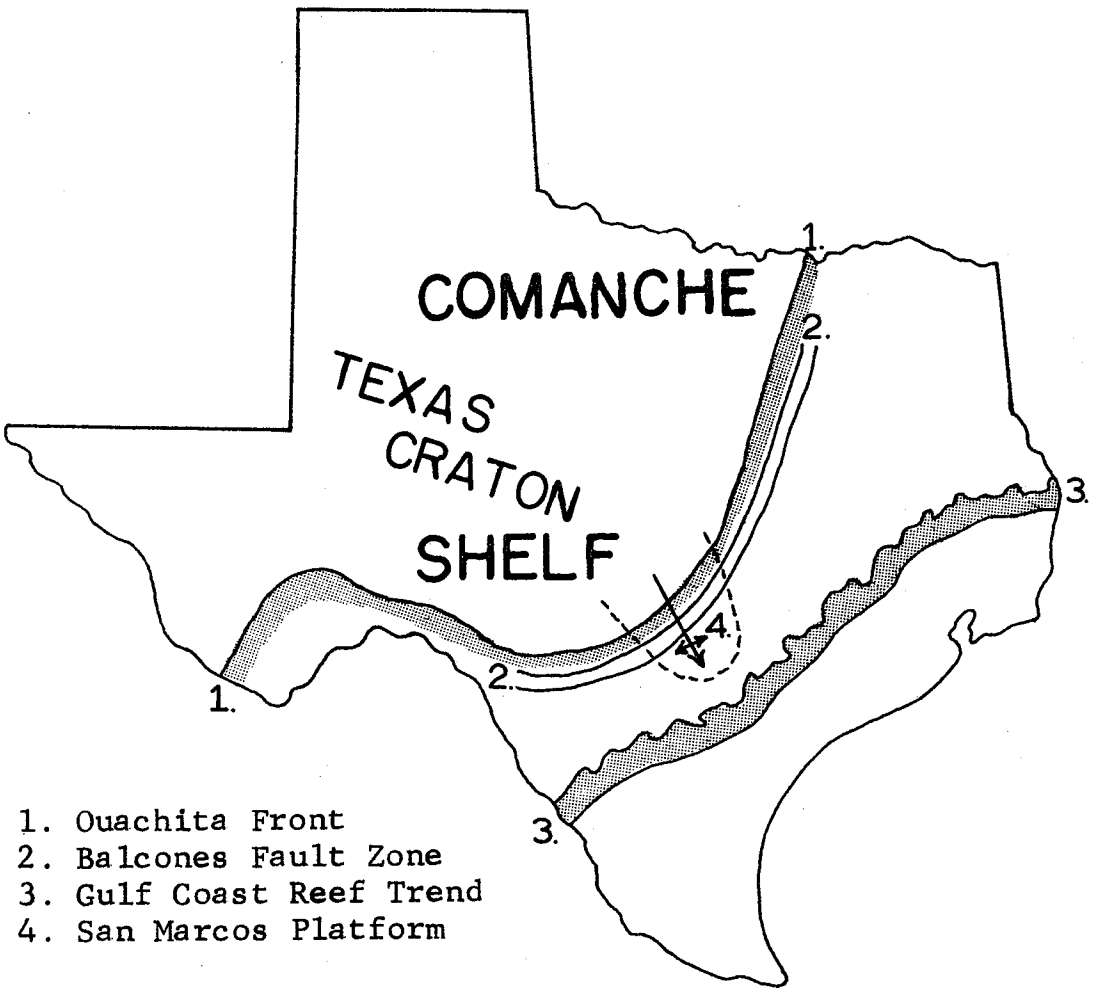

Figure 2.
Regional Geologic Elements

et al. (1961) recognize two tectonic zones in the foldbelt that are defined on degree and type of deformation and degree of metamorphism. The outer or frontal zone is marginal to the Texas craton and is characterized by strong folding and faulting and by unmetamorphosed to very weakly metamorphosed sedimentary rocks. The inner or interior zone is composed of weak to low grade metasedimentary rocks that have undergone deformation with a high shear component. Flawn *et al.* (1961) have also defined and mapped four lithologic units: 1. Cambrian (?) through Devonian (possibly including Lower Mississippian) rocks; 2. Mississippian-Pennsylvanian rocks; 3. dark, fine-grained to coarse grained, clastic rocks of unknown age; and 4. phyllite, slate, metaquartzite, marble, and schist of unknown age.

The Texas craton and Ouachita structural belt are important to the geology of the Wimberley area because they served as the basement upon which the Cretaceous rocks of the area were deposited and because the boundary between them is a zone of structural weakness along which the Balcones fault zone has developed. The thesis area is situated over the frontal zone of the Ouachita belt and the basement rocks under the area have been mapped by Flawn *et al.* (1961) as Mississippian-Pennsylvanian.

Balcones Fault Zone: The Balcones fault zone is a band of fractures extending from north-Texas south, southwest, and west in a broad arc through the central part of the state (Fig. 2). It passes through Austin and San Antonio and continues westward. The zone was named for the Balcones Escarpment, the present-day topographic expression of the zone. This fault-line scarp is most conspicuous between Austin and San Antonio. The Balcones fault zone is composed of many *en echelon,* normal, synthetic, down-to-the-coast strike faults, which together form the northwest side of a northeast trending faulted graben. The southeast side of the graben is formed by the up-to-the-coast faults of the Luling fault zone (Weeks, 1945).

Balcones faulting resulted from tensional stresses caused by uplift of the Edwards Plateau relative to the Gulf Coastal Plain. Estimates of the age of the faulting range from the Cretaceous Period to the Pleistocene Epoch. Considerable movement must have occurred during the Miocene because the Oakville, a Gulf Coastal Plain formation of that age, contains calclithite and reworked Cretaceous fossils that indicate uplift and erosion

of the Cretaceous strata to the west (Folk, 1955).

The location of the Balcones zone, as previously stated, is controlled by the zone of structural weakness at the boundary between the Texas craton and the Ouachita structural belt. George (1952) cites a cumulative displacement on the zone of about 1500 feet across Comal County and DeCook (1963) gives a figure of 1700 feet for Hays County.

Comanche Shelf, Gulf Coast Reef Trend, and San Marcos Platform: The term Comanche shelf was used by Rose (1968) for the vast, flat, generally submerged plain which, during Comanchean time, included most of Texas except the present southeast margin of the Gulf Coastal Plain. It was on this surface that the sediments of the Cretaceous Comanche Series accumulated. The shelf was separated from the deeper waters of the the ancestral Gulf of Mexico basin to the southeast by the Gulf Coast reef trend. This belt is composed of a series of long, narrow, slightly sinuous, stacked reefs that trend generally parallel to, but several miles inland from, the present Texas coast line. These reefs grew intermittantly throughout most of Comanchean time and profoundly affected depositional conditions in the shelf area behind it. The reef trend was originally named the Stuart City Reef by Winter (1962), but that name is now restricted to the reef that grew during deposition of the Edwards Formation and other names have been applied to the older reefs (Hendricks and Wilson, 1967).

Two large depressions, the Maverick Basin on the southwest and the North Texas-Tyler Basin on the northeast, were superimposed on the Comanche Shelf. These basins were separated by the Central Texas Platform (Rose, 1968; =Comanche Platform, Cartwright, 1932), a broad, elongate swell bearing southeasterly from the vicinity of San Angelo, Texas, across the Llano uplift to the Gulf Coast reef trend. The southeast end of the Central Texas Platform is called the San Marcos Platform (Rose, 1968). The San Marcos Platform was originally called the San Marcos Arch by W. S. Adkins (1933), who thought that the San Marcos River flows approximately down the arch axis. Winter (1962) changed the name to San Marcos Platform because it has no present topographic expression and its existence is inferred from the thinning of Cretaceous units over its crest. The axis of the platform trended southeastward between San Marcos and New

Braunfels and probably shifted back and forth in that vicinity during Comanchean time (Keith Young, personal communication).

The Wimberley area is situated on the northeast flank of the San Marcos Platform many miles inland from the Gulf Coast reef trend.

STRATIGRAPHY

Rocks of two systems, the Cretaceous and the Quaternary, crop out in the Wimberley area. The age of the basement rocks, as previously stated, is Mississippian and Pennsylvanian. Triassic and Jurassic rocks are present below the surface of the Gulf Coastal Plain, but they pinch out several miles southeast of the thesis area. Several Cretaceous formations are present below the surface of the area and three formations, the Glen Rose, the Walnut, and the Edwards, are exposed at the surface. Quaternary alluvium, colluvium, and upland deposits cover the older strata in several places.

CRETACEOUS SYSTEM

Cretaceous rocks ranging in age from Late Aptian to Middle Albian (Young, 1966, 1967b) are exposed at the surface in the Wimberley area (Figure 3). The stratigraphy of the Cretaceous System in Texas was largely established by R. T. Hill in the late 19th and early 20th centuries. Hill divided the system, using the concept of sedimentary cycles, into two series, the Comanche below and the Gulf above. A series, as Hill conceived it, was deposited during a major cycle of sedimentation and represented a "complete Ternary succession of strata, to-wit: 1. A lower stage of sandstones, shales, and other sedimentary deposits, representing prevalence of land with downward movement. 2. A middle stage, chiefly of limestone, representing prevalence of sea, and general quiescence and elaboration of calcareous organic formations. 3. An upper stage, and more of mechanical sediments, indicative of proximity to land." (Hill, 1889, p. xv)

Hill divided the Comanche Series into three "divisions" which are, in ascending order, the Trinity, the Fredericksburg, and the Washita. Each division was deposited as a smaller sedimentary cycle superimposed on the larger Comanche cycle. Although it is not recognized in the Code of Stratigraphic Nomenclature (American Commission on Stratigraphic Nomenclature, 1961), the division is a formal stratigraphic unit which,

System	Substage (Young, 1967)	Group	Formation	Member	Thickness (feet)
CRETACEOUS	Middle Albian	Fredericksburg	Edwards		93.0
			Walnut	Bee Cave	10.5
				Bull Creek	23.8
	Lower Albian	Trinity	Glen Rose	G	120.9
				F	87.7
				E	44.4
				D	98.5
				C	52.6
				B	60.4
				A	88.0
	Upper Aptian				

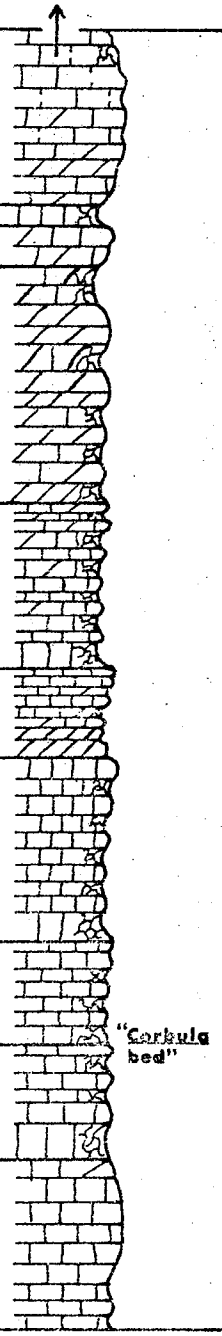

Figure 3.

Columnar Section of the Cretaceous System in the Wimberley Area

because it is bounded by isochronous surfaces, is equivalent to the time-stratigraphic unit defined in the Code (Young, 1967a). Adkins (1933) used Hill's divisions in a rock-stratigraphic sense by referring to them as groups. At the present, the Trinity, Fredericksburg, and Washita may be regarded either as divisions or as groups. The choice of which is used depends on the size of the area being studied and the point of view that is presented. The division is most useful for regional work and for interpretations of origins of rock units. The group is more useful for mapping in small areas (Young, 1967a). The Trinity, Fredericksburg, and Washita are regarded here as groups because the thesis area includes a relatively small portion of the Texas Comanche rock body, both in areal extent and in the total stratigraphic section represented, and because the units mapped are rock stratigraphic; that is, they are formations and members. Parts of two groups, the Trinity and the Fredericksburg, crop out in the Wimberley area.

Trinity Group

Hill (1889, p. xv) named his Trinity Division for excellent exposures along West Fork and Clear Fork of the Trinity River northwest of Fort Worth. After he made several changes in the formations that compose the Trinity (Young, 1967a, p. 13, table 2), Hill finally (1937) decided to include in it the Glen Rose and underlying formations. Several formations of the Trinity Group are present below the surface of the Wimberley area, but the group is represented only by the upper part of the Glen Rose at the surface.

Subsurface formations

Four formations of the Trinity Group are present below the surface of the Wimberley area. They are, in ascending order, the Hosston and Sligo (Sycamore), the Pearsall (Hammett and Cow Creek), and the Hensel Formations. Because this study is a surface mapping project, these units were not studied and will be discussed only briefly here. The data given are taken from other authors, chiefly Young (1967a).

The Hosston Formation, a transgressive, dominantly terrigenous unit, is a shoreward shale and sand facies of the overlying marine Sligo Formation and is the subsurface rock-stratigraphic equivalent of the outcropping Sycamore Formation. The Sligo Formation, which is primarily a marine limestone, does not crop out in the central Texas region. The Pearsall Formation is the subsurface equivalent of the combined

Hammett and Cow Creek Formations (Forgotson, 1957), which are exposed north and northwest of the Wimberley area. The Hensel Sand, which is a shoreward sand facies of the Glen Rose Formation, thins to the south and southeast as a result of replacement by Glen Rose strata.

Glen Rose Formation

The Glen Rose is the most extensive formation in the Wimberley quadrangle, cropping out over about 90% of its area. The formation was originally named the *Caprotina* Limestone by Shumard (1860, p. 588). Hill initially (1889, p. xvii) called it the "basal or alternating beds" but later formally named it the Glen Rose Limestone (1891) and designated the type section along the Paluxy River near the town of Glen Rose, Somervell County. This type section is in the thinned, updip, nearshore extension of the formation.

The Glen Rose is primarily a carbonate deposit with varying amounts of clay. It was laid down on the Comanche Shelf in the vast lagoon behind the Gulf Coast reef trend. This back reef area possessed several types of depositional environments in which the Glen Rose sediment accumulated. Young classed the environments into four broad categories: "(1) nearly normal saline environments as indicated by the micrites with diverse mollusc assemblages; (2) tidal flats that are represented by the flats on which dinosaurs left their tracks; (3) biogenic growths now represented by tabular and biohermal rudistid and coral reefs; and (4) hypersaline environments represented by evaporite beds, celestite bearing beds, and fine-grained dolomites" (Young, 1967a, p. 18). Recent reports on selected portions of the Glen Rose by paleoecology classes at the University of Texas at Austin (Scott, *ed.*, 1967, 1968) show that a variety of environments at or very close to sea level existed during Glen Rose deposition. Three basic environments - subtidal, intertidal, and supratidal - are recognized and are shown to be related to each other vertically in a logical facies sequence that is a reflection of cyclic deposition: "The repetitious nature of Glen Rose rocks suggests a cyclic onlap-offlap sequence. The actual cycles may be thought to begin by a rapid transgression followed by a longer period of regression or depositional progradation. Onlap sequences are seldom well represented in Glen Rose sediments. The offlap phase is probably due to

progradation as a result of subsidence. The record in an ideal offlap sequence would then be subtidal, intertidal, ending in a beach and/or marsh. This ideal is seldom, if ever, realized." (Bishop, 1968, p. 3)

The upper 553 feet of the Glen Rose Formation is exposed in the Wimberley area. The total thickness of the formation is given below. The lower contact does not crop out within the confines of the area but is exposed less than five miles to the west. The upper contact in Hays and Comal County area has been described by Moore (1964, p. 6): "The Bull Creek Limestone unconformably onlaps the Glen Rose to the northwest and west; this unconformity seems to die out to the south and the Bull Creek and Glen Rose intercalate." No evidence for an unconformity was observed in the thesis area.

The Glen Rose, at its outcrop belt in the central Texas region, has been arbitrarily divided into two members, the Upper and the Lower, at a key bed known as the "*Corbula* bed." This key bed was first recognized and utilized by F. L. Whitney, who noted its persistent association with the subjacent "*Salenia texana* marl" and its constant relation to the top of the Glen Rose (Lozo and Stricklin, 1956). The "*Corbula* bed" will be described more completely in a later section. Tucker (1962, p. 188, fig. 6) has constructed an isopachous map of the Lower Glen Rose indicating that the member ranges in thickness from 300 feet in the northern part to about 400 feet in the southern part of the area. Measured sections for this study show that the Upper Glen Rose is approximately 400 feet thick. Thus the thickness of the entire Glen Rose Formation in the area ranges from 700 to 800 feet.

The Glen Rose Formation in the Wimberley area is divided here into seven cartographic units designated in ascending order by the letters A through G. The purpose of defining these units is to classify stratigraphic information of the Glen Rose, to allow more detailed mapping of the thesis area (Plate 1), and to provide control horizons for locating faults and determining their displacements. The units are considered to be informal members because they do not fit the definition of formal members (Code of Stratigraphic Nomenclature, American Commission on Stratigraphic Nomenclature, 1961) in the following respects: 1. They are defined chiefly on mappability; 2. There is as much lithologic variation within some of the members as there is between different

members; and 3. The members are not given geographic names. The establishment of formal members of the Glen Rose Formation must await study of the formation over a larger area than the Wimberley area. The members defined here may or may not be valid or useful outside the thesis area.

A condensed discussion of the lithology and fossil content of each of the members is given below; a more detailed bed by bed description appears in the Appendix and Plate 2. The vegetation growing on each of the members is also discussed below and, because the members are defined primarily on air photograph mappability, their air photograph characteristics will also be described. The data given for each of the members are taken from areas where their full thicknesses are exposed and their outcrops are good.

Member A: Member A is composed of the oldest exposed strata in the Wimberley area. The outcrop area of the member is confined to the part of the drainage basin of Cypress Creek that lies northwest of Jacob's Well fault. The description of the member given below applies only to its upper 88 feet, the portion that is exposed in the Wimberley area.

The upper 54 feet of Member A consists of very thick bedded, massive, resistant, gray-weathering limestones that range in composition from fossiliferous micrite to packed biomicrite. The 34 feet of strata below these limestones is composed of thin to medium bedded limestones and marls. A single 9 foot thick bed of massive limestone occurs about 68 feet below the top of the member.

The base of Member A is defined as the base of the Glen Rose Formation. Approximately the upper 88 feet of Member A crops out at the surface and a sample taken from inside Jacob's Well about 54 feet below the base of the surface outcrop had Glen Rose and not Hensel lithology, indicating a minimum thickness of 142 feet for the member.

The top of the member (Figure 4) is usually marked by a sharp break in slope and by a well defined change in tone on air photographs. The break in slope is caused by change in lithology from the thick, resistant limestones of the upper part of Member A to the less resistant marls of Member B and the tonal change results from a change in the density of vegetation from very dense on A to moderately sparse on B.

Figure 4.

Contact between Members A and B

Northwest view showing the massive, thick bedded limestones at the top of Member A and the thinner bedded marls and limestones at the base of Member B. The break in slope at the contact is also visible, but the normal greater abundance of vegetation on Member A than on Member B is not displayed. The photo was taken near Mt. Sharp Road about 0.5 miles northwest of the intersection with Jacob's Well Road.

The appearance of Member A on air photographs is generally different from the rest of the Glen Rose because it lacks the distinctive well-bedded, contoured appearance of the rest of the formation, appearing instead relatively massive, unbedded and homogeneous. The member supports a dense growth of mixed live oaks and junipers, and thickets of shin oaks (*Quercus harvardii*?) also grow profusely in some areas.

Member B: Member B is 60 feet thick. With the exception of a narrow, mostly covered outcrop band along the Blanco River upstream from Wimberley fault, outcrops of the member are present only on either side of the Cypress Creek drainage basin northwest of Jacob's Well fault and on both sides of Cypress Creek in the fault block between Jacob's Well and Tom Creek faults. The member is composed of three thick, non-resistant, recessive marls that are separated by thin to medium bedded limestones and marly limestones.

Miliolids, orbitolines, and serpulids are common in the member and *Monopleura* sp. were observed in at least two beds. The seven to eight foot thick "*Salenia texana* marl" near the top of the member is one of the most fossiliferous beds of the Glen Rose Formation.The regular echinoid *Salenia texana* Credner, the namesake of the bed, rarely occurs in any other Glen Rose strata. Other fossils present in the *Salenia* zone are several species of regular and irregular echinoids, extremely abundant orbitolines, several species of pelecypods in the form of "heart clam" steinkerns, serpulids, *Nerinea* sp., *Porocystis globularis* Giebel, and fragmented oysters.

The lower boundary of Member B was described in the summary of Member A. The upper boundary is defined as the top of the "*Corbula* bed," the key bed which divides the Glen Rose Formation into its formal Lower and Upper Members. This distinctive stratum is easily recognized in the field because it is heavily iron stained and it contains a profusion of the small clam *Corbula harveyi* (=*Corbula martinae* Whitney, 1952a; =*Leda harveyi* Hill, 1893) which superficially resembles large wheat grains. The bed is also usually ripple-marked with low amplitude symmetrical ripples (Figure 5). This key bed is an excellent mapping horizon not only because it is readily recognized in outcrops, but also because it is easily traced on air photographs, appearing as a thin, continuous black line separating lighter-toned areas on either side. This line is caused by an abundance of trees in a generally sparsely vegetated interval.

Figure 5.

Contact between Members B and C

Two views of the "*Corbula* bed", the contact between Members B and C. The upper print shows the characteristic ripple-marked upper surface of the bed. The lower print is an eastward view showing the subjacent "*Salenia texana* marl" capped by the "*Corbula* bed". Several moderately resistant marly limestones separate the "*Corbula* bed" from the lower, marly part of the "*Salenia* marl."

Member B possesses the characteristic well-bedded, contoured appearance of the Glen Rose on air photographs. The sparse tree population on the member is made up of mixed live oaks and junipers.

Member C: The 53 foot thick Member C crops out on both sides of the Cypress Creek drainage area northwest of Jacob's Well and Lone Man faults and in the west central half of the area between Wimberley fault and Jacob's Well fault. It is composed of interbedded recessive marls and more resistant limestones. The limestone beds are usually slightly dolomitic. In the lower part of the member, the limestone beds are thinner than the marls but in the upper part of the member the limestones are thicker than the marls. A distinctive 4.5 foot thick bed in the lower part of the member, which is composed of a network of textureless sparry calcite veins, was probably originally deposited as an evaporite.

Fossils are not abundant in Member C. Miliolids are the most frequent, occurring in several beds in the lower and upper parts of the member. Three thin flags of *Corbula*-bearing limestone occur near the base, but they are easily distinguished from the stratum used to separate Members B and C because they are much thinner and are not ripple-marked.

The lower boundary of Member C was described in the discussion of Member B. The upper contacts of Members C, D, and E are similar (Figure 6) in that they are defined at changes in lithology that are expressed on air photographs as sharp breaks in slope and tone. The upper boundary of Member C marks a change from medium bedded, resistant limestones at the top of the member to much less resistant, thick marls in the lower part of Member D. The contact is usually marked on air photographs by a sharp break in slope and by a sudden tonal change. The change in slope is usually marked by a decrease in slope upward from the resistant limestones of the upper part of C to the nonresistant marls at the base of D. The change of tone is from dark near the top of C, where live oaks and junipers are abundant, to very light on the almost barren marls near the base of D.

The air photograph characteristics of Member C are similar to those of Member B; that is, the member appears well bedded and trees are moderately sparse. Near the top of the member, however, the trees become much more abundant. The trees are mixed live oaks and junipers.

Member D: Member D, which is about 99 feet thick, is one of the most widespread units in the Wimberley area. It is composed of interbedded limestones, marls, and marly limestones. The poorly resistant marls are generally thicker than the resistant limestones, and they form the greater portion of the lower part of the member. The limestones, however, gradually constitute a greater part of the section upward, until near the top of the member they predominate.

Member D is moderately fossiliferous. The most abundant fauna are orbitolines and miliolids. The first occurrence of orbitolines above the *Salenia texana* marl of Member B is from 6 to 12 feet above the base of Member D. Miliolids are scattered through many beds within the member. The algal fruiting body *Porocystis globularis* Giebel was observed in 2 beds in the member, one near the base and the other near the top. Pelecypod steinkerns are common in several beds near the middle of the member. Rudists, including both *Monopleura* sp. and *Toucasia* sp., were observed about 12 feet above the base of the member.

The lower boundary of Member D was described in the summary of Member C. The upper contact (Figure 6) is defined at a sharp break in slope associated with the change in lithology from the hard, resistant limestones at the top of the member to the less resistant dolomites at the base of Member E. In areas of moderate relief, the contact is also marked by a change of tone from the dark tone of the densely vegetated limestones at the top of Member D to the light tone of the more sparsely vegetated dolomites near the base of Member E.

On air photographs, Member D exhibits the characteristic well bedded appearance of the Glen Rose. The tone of the member grades from very light on the sparsely vegetated marls near the base to dark on the more densely vegetated limestones near the top. Member D supports a tree population of mixed live oaks and junipers. The junipers are dominant, although sparse, near the base and the oaks predominate near the top of the member.

Member E: Member E, which is about 44 feet thick, occurs in three parts of the Wimberley area. It circumscribes Lone Man and Lone Woman Mountains in the northeastern part of the area, it crops out in the central part of the area on the fault

Figure 6.

Contact between Members D and E.

Southeast view showing the break in slope at the contact of the hard, resistant limestones at the top of Member D and the softer, less resistant dolomite beds at the base of Member E. The contacts between Members C and D and between Members E and F show a similar break in slope associated with a change from resistant limestones below the contact to less resistant beds above.

block between Tom Creek and Wimberley faults, and a narrow outcrop band is present immediately south of the Blanco River and east of Wimberley fault.

The lower 16 feet of Member E comprises several sacchoroidal, porous dolomite beds that have little or no trace of their original limestone textures. The next 6 feet is a distinctive dolomitic marl, and the remainder of the member is composed of a sequence of dolomites, dolomitic limestones, and hard, resistant limestones. The resistant limestones compose a greater part of the section upward, until near the top of the member, they form the entirety of the section.

Aside from miliolids, which occur sporadically through the entire member, fossils are not abundant. Several specimens of *Porocystis globularis* Giebel are present in the dolomitic marl above the basal dolomite beds and abundant *Monopleura* sp. were noted near the top of the member.

The lower boundary of Member E was described in the discussion of Member D. As in Members C and D, (Figure 6) the upper boundary of Member E is defined at a sharp break in slope. The slope break at the contact between Members E and F is caused by a change in lithology from the hard, resistant limestones at the top of Member E to much less resistant marls at the base of Member F. In areas of moderate relief, the contract is also marked by a change of air photograph tone from dark on the rather densely vegetated limestones at the top of Member E to light on the sparsely vegetated marls of Member F.

The tone of Member E gradually changes from light on the dolomitic and marly lower part to dark on the resistant limestones of the upper part of the member. The tree population of Member E is composed of mixed live oaks and junipers.

Member F: The most extensive outcrops of the 88 foot thick Member F are along the high relief area south of the Blanco River across the entire width of the thesis area. Other less extensive occurrences are in the northern and northeastern part of the area in the vicinity of Lone Man and Lone Woman Mountains, in the central part of the area around Little Twin Sisters Peaks and Joe Wimberley Mountain, and along the eastern margin of the area south of Lone Man fault. The member is composed of thick marls separated by thin interbeds of resistant limestones. The member is dolomitic in its upper part, with the dolomite content increasing upward.

Member F is moderately fossiliferous. Miliolids are abundant through the entire section. Two beds in the upper part of the member contain an abundance of the regular echinoid *Loriola* sp. and are the most fossiliferous in the member. These beds contain, in addition to *Loriola* sp., abundant oyster fragments, gastropods, serpulid fragments, clam steinkerns, and occasional specimens of *Neithea* sp.

The lower contact of Member F was described in the section on Member E. The upper contact (Figure 7) is defined as the base of the lowest dolomite bed of Member G. This bed is the lowest stratum above the dolomites of Member E which, when weathered, is a massive, saccharoidal, porous dolomite bed. The measured section including this contact was on a relatively fresh roadcut, and the lowest bed of Member G was not a dolomite, but was instead a dolomitic limestone, indicating that the calcareous content of this stratum is removed by solution when the bed is weathered. On air photographs the contact is marked by a subtle change in slope (Figure 7) and by a well defined change in weathering character from the rounded appearance of Member G to a more angular and "fluted" appearance of the upper part of Member F. The contact is also marked by a change of tone from light on the sparsely vegetated Member F to very light on the very sparsely vegetated Member G. Member F appears almost homogeneous on air photographs, displaying little of the characteristic contoured appearance of the Glen Rose. The sparse growth on Member F is composed almost exclusively of junipers.

Member G: Member G, which has a thickness of 121 feet, is the thickest member of the Glen Rose. It crops out most extensively in the high relief area south of the Blanco River in a wide band that, like Member F, crosses the entire width of the thesis area. It is also exposed on high relief hills along the eastern margin of the area south of Lone Man fault and at the tops of other high hills, including Lone Man and Lone Woman Mountains, the Little Twin Sisters Peaks, and Joe Wimberley Mountain.

The member is composed of interbedded limestone, dolomitic marl and limestone, and dolomite. The dolomite beds are saccharoidal, fine to medium crystalline, and medium to thick bedded. Although relict features are common in these beds, dolomitization has effaced most of the original limestone textures and structures. Most of the intervening limestones and marls between the dolomite beds are dolomitic.

Figure 7.

Contact between Members F and G

Westward view of the westernmost mountain of the Little Twin Sisters Peaks showing the break in slope and the change in abundance of vegetation at the contact between Members F and G.

Approximately the upper 21 feet of the member comprises a sequence of interbedded dolomite and pulverulite (chalky, porous calcium carbonate) beds that are laced with textureless sparry calcite veins. "Distorted bedding" and collapse breccia were also seen. These beds are interpreted to be evaporitic deposits from which the evaporite minerals have been removed by solution.

Member G contains few fossils, partly because the depositional environment may not have been suited for a prolific fauna and partly because much of the fossil content may have been effaced by dolomitization. Abundant burrows, however, indicate considerable biogenic activity.

The lower boundary of Member G was described in the discussion of Member F. The upper boundary is the contact of the Glen Rose Formation and the Bull Creek Member of the Walnut Formation which has been discussed. This horizon is difficult to map because it is marked by neither a break in slope nor a change in tone on air photographs. It must normally be traced by assuming a constant thickness of the Bull Creek Limestone and placing the contact a distance equal to that thickness below the more easily mappable Bull Creek—Bee Cave contact above. On air photographs Member G exhibits the characteristic well-bedded, contoured appearance of the Glen Rose Formation. It is very light toned in its lower part because it supports only a very sparse population of trees that are almost exclusively junipers. The tone becomes darker upward owing to an increasing density of vegetation until near the top of the member the tone is dark. The tree population in the upper part of the member is composed primarily of junipers with occasional live oaks.

Fredericksburg Group

The Fredericksburg was first named by Römer (1846) for the town of Fredericksburg in Gillespie County. Römer was unaware of the Balcones fault zone and thought the Fredericksburg strata overlay younger Cretaceous strata of the Gulf Coastal Plain. Hill recognized the correct stratigraphic position of the Fredericksburg and used the name for the intermediate division of his Comanche Series (1887b, p. 301). Moore, who has recently done a regional study of the Fredericksburg in nine counties of central Texas including Hays and Comal Counties, recognizes three formations in the

Fredericksburg which are, in ascending order, the Walnut, Comanche Peak, and Edwards Formations. Moore's stratigraphic classification, because it is the most recent and comprehensive in the area, is used here. The Edwards Formation, according to Moore, thickens southward from the Williamson County area and replaces the Comanche Peak Formation and the upper members of the Walnut Formation by facies change.

The Fredericksburg Group in the Wimberley area is most extensive on the upland in the southern part of the area. Smaller outcrops are present along the eastern margin in the northern half of the area on the downthrown side of Lone Man Fault.

Walnut Formation

The Walnut Formation was named by R. T. Hill (1891, p. 512) for exposures near the town of Walnut (now Walnut Springs), Bosque County.

Moore (1964) divided the Walnut into five members in his regional study of the formation in central Texas. In ascending order, they are the Bull Creek, Bee Cave, Cedar Park, Keys Valley, and "upper marl" members. The upper three Members, as well as the overlying Comanche Peak Formation, are replaced by the Edwards in the Wimberley area, and only the Bull Creek and Bee Cave Members are present. The Bee Cave also pinches out south of the thesis area because of facies replacement by the Edwards. Before Moore's classification of the Walnut, the strata that comprise the Bull Creek Member were included in the Glen Rose Formation and the Bee Cave alone was considered to represent the Walnut in Hays County.

The thickness of the Walnut Formation in the Wimberley area is about 34.5 feet. The Bull Creek and Bee Cave Members are mapped as separate units in areas of low to moderate relief where they can be distinguished on air photographs, but they are grouped together and mapped as undifferentiated Walnut Formation in areas of steep relief where the contact between the two members cannot be recognized on air photographs and where the upper and lower contact lines of the Walnut are too close together on the map to allow room for the Bull Creek–Bee Cave contact line.

Bull Creek Member: Moore (1961, p. 22) named the Bull Creek Member for exposures in the drainage of Bull Creek west of Austin, Travis County. The member is about 24 feet thick in the Wimberley area and is composed of hard, resistant, medium

bedded limestones and dolomitic limestones that are mostly biomicrites and intraclastic biomicrites. A single bored surface was noted about 7.5 feet below the top of the member.

Although gastropods are common, other macrofauna is sparse in the Bull Creek. Miliolids occur through most of the thickness of the section. Moore (1964, p. 27), in his facies analysis of the Fredericksburg, classed the Bull Creek in his "intraclast facies" and identified the depositional environment as relatively high energy shallow marine. He believed the member to be "a submarine bar-type deposit parallel to the shore, possibly analogous to the present Mustang Island along the Gulf Coast of Texas." (1964, p. 27)

The lower boundary of the Bull Creek was discussed in the section on the Glen Rose Formation. The upper contact is pitted, corroded, and iron-stained, suggesting that the Bull Creek may have been emergent for a time before the onset of Bee Cave deposition. This distinctive horizon, according to Moore (1961, p. 25), is traceable throughout central Texas. The Bull Creek supports a dense growth of mixed live oaks and junipers and consequently has a dark tone on air photographs.

Bee Cave Member: The Bee Cave Member was named by Moore (1961, p. 26) and the type section was designated just west of Austin, Travis County. The member is 10.5 feet thick in the Wimberley area and is composed of a single fossiliferous nodular marl bed (Figure 8). The overwhelmingly dominant fossil is the oyster *Exogyra texana* Römer, but several species of echinoids, gastropods, and clams are also present.

Because the Bee Cave is a relatively thin and poorly resistant marl sandwiched between the resistant limestones of the Bull Creek and Edwards, it is, in areas of low to moderate relief, the most easily mappable unit in the Wimberley area. Both the upper and lower contacts are marked by sharp breaks in slope and by changes in tone. The light toned Bee Cave appears as a white band between the darker toned underlying Bull Creek and overlying Edwards limestones.

The Bee Cave supports a population of mixed live oaks and junipers. The growth is sparse in areas of low to moderate relief and dense where relief is high.

Edwards Formation

The Edwards Formation was first named the *Caprina* Limestone by Shumard (1860, p 584). Hill initially called it the "Barton Creek Limestone" to replace the

Figure 8.

The Bee Cave Marl

Westward view of the Bee Cave Member of the Walnut Formation showing characteristic nodular appearance. The motorcycle rests on the Bull Creek-Bee Cave contact. The Bee Cave-Edwards contact (indicated by arrow) is at the base of the lowest resistant limestone above the marl.

paleontologic name used by Shumard, but Hill and Vaughan (1898a, p. 2; 1898b, p. 227-235) renamed it the Edwards Formation for the Edwards Plateau. Although Hill probably considered Barton Creek near Austin the type section, he failed to designate it formally and the task was fulfilled by Adkins (1933, p 339).

Rose (in press) has studied the Edwards in central Texas and is raising it to group status using two sets of formational nomenclature, one for surface exposures on the Edwards Plateau and the other for the subsurface between the Balcones Fault Zone and the Gulf Coast Reef Trend. He recommends usage of his subsurface formations, the Kainer below and the Person above, for the Edwards outcrops within the Balcones Fault Zone. The Edwards in the Wimberley area is considered here to be a formation because only the lower part of the Kainer is present and because Rose's study has not yet been published.

The maximum thickness of the Edwards in the Wimberley area is about 130 feet on one of the upland hills in the southern part of the area. The lower 93 feet was measured and described in a very poorly exposed section; the remainder of the section is too badly covered with soil and vegetation for description. The portion described is composed mostly of dolomitized or recrystallized limestones. Bluish gray chert nodules with white patina were observed about 85 feet above the base of the formation.

With the exception of a few recognizable miliolids in scattered beds and occasional rudists, the Edwards, at least in the section measured, is largely unfossiliferous.

The Edwards supports a dense growth of mixed live oaks and junipers. Prickly pear cactus and Texas (black) persimmon (*Diospyros texana*) are also abundant. The vegetation displays well developed bedding control that is exhibited as alternating bands of dense and sparse vegetation.

QUATERNARY SYSTEM

Quaternary deposits of three different types are present in the Wimberley area. Alluvial deposits were laid down by perennial and intermittent streams, colluvium was deposited directly by the action of gravity, and upland deposits remain at or near the place of their release from bedrock. Only the alluvial deposits are extensive enough to map.

Alluvium: Alluvial deposits of clay through gravel size occur along the Blanco River and Cypress Creek and along the courses of small intermittent streams. These deposits are composed mostly of limestone gravel with clay matrix. Their thicknesses are variable, approaching 40 feet in some of the terraces of the Blanco River.

Colluvium: Colluvial blocks up to 50 feet in length have dropped from cut banks of Cypress Creek in the portion of the creek that flows in Member A. These blocks have fallen as the result of undercutting by the creek.

Upland deposits: The upland areas having Glen Rose bedrock, where relief is relatively low, are covered with a veneer of limestone gravel and dark brown to black soil. The Edwards Formation on the upland area in the southern part of the thesis area is mantled with a regolith of reddish brown terra rosa type soil and a residuum of chert and limestone gravel. These deposits are at or near the point of their release from bedrock. No stream-worn or percussion marked chert gravel characteristic of "Uvalde-type" gravel was observed.

STRUCTURAL GEOLOGY

Three major kinds of structural features occur in the Wimberley area. Several faults of the Balcones system transect the area, numerous joints are present in the harder, more resistant limestone beds, and the strata throughout the area dip gently to the southeast.

Faults

Six major Balcones faults pass through the Wimberley area, and several minor faults cross some parts of the area. Like most faults of the Balcones system, these faults are normal, northeast trending, southeast dipping strike faults. The dips of the fault surfaces cannot be measured accurately because, although occasional fault outcrops do occur (Figure 9), they are not well enough exposed to permit measurement of dip angle. The traces of the faults are not appreciably affected by topography, indicating that the faults are nearly vertical. Displacement on the faults may be confined to a single surface or it may be distributed over a zone of varying width.

The faults in the Wimberley area seldom have appreciable topographic expression.

They are either intraformational or they displace different formations having about equal resistance to erosion into contact with each other so that erosion has proceeded at an equal rate on both sides of the faults and no fault-line scarps have formed. The most useful method of locating the faults is to find displaced stratigraphic horizons. One of the primary reasons for subdividing the Glen Rose Formation, as previously stated, was to provide such control horizons for locating faults and determining their displacements. Another good indicator of faulting in an area is the presence of dipping beds; that is, of beds with sufficient dip to be easily seen in the field. Such high angle dips are usually caused by solution collapse or drag along a fault and are confined to the immediate vicinity of the fault.

If a fault is suspected in an area, it can usually be mapped accurately by examining aerial photographs for lineations. Although lineations can frequently be seen by using the photographs as stereo pairs, they are more conspicuous if the photographs are used singly and are viewed obliquely down the trace of the suspected fault. When viewed in this way, the linear features "line up" and the faults can be mapped easily and accurately.

The major faults and some of the minor faults in the area are described below. The general trends of the fault traces are given, but, because the traces are slightly irregular or serrate, the bearing of a trace at a particular point may differ considerably from the general trend. The stratigraphic separation (Badgley, 1965), referred to below simply as displacement, has been determined at several places along each of the faults by comparing elevations of stratigraphic horizons on both sides of the faults. These elevations, which were taken from the topographic base map, are normally accurate to about 15 feet, so that in most cases the accuracy of the displacement is about ±30 feet. The accuracy is greater for small-displacement faults and less where strata of fault blocks on either or both sides of the fault dip relatively steeply or where different stratigraphic horizons on either side of the fault must be used.

Major Faults

Lone Man Fault: The name Lone Man is applied here to a major displacement fault situated near the eastern boundary of the thesis area about 1½ miles south of Lone

Man Mountain. At its southwest end, near the intersection of Texas F.M. 12 and Jacob's Well Road, the fault splits into two smaller faults – Jacob's Well fault and Tom Creek fault. The portion of the fault located in the Wimberley area has a bearing of approximately N58°E, and its displacement is about 275 feet downward to the southeast. A short distance east of the area the Edwards formation has been faulted down into contact with Member D of the Glen Rose formation.

Jacob's Well Fault: The northern branch from Lone Man fault is named here for Jacob's Well, a large perennial spring in the bed of Cypress Creek about 300 yards upstream from the fault (Frontispiece). The trace of Jacob's Well fault is slightly irregular to serrate, but its average trend is N55°E. The contact between Members B and C is displaced downward to the southeast approximately 150 feet along Jacob's Well Road and about 100 feet in the vicinity of the intersection of Jacob's Well Road and Texas F.M. 2325. The fault begins in the northeast where it branches from Lone Man fault near the intersection of Jacob's Well Road and Texas F.M. 12. It progresses along the northeast portion of Jacob's Well Road to the intersection with Mt. Sharp Road and continues southwestward from there. The fault crosses the western boundary of the thesis area about ½ mile south of Fischer Store Road.

Jacob's Well Fault is the best exposed fault in the Wimberley area (Figure 9). It is also well expressed as a lineation on aerial photographs, especially on the unnamed hill ½ mile southwest of the intersection of Jacob's Well Road and Texas F.M. 12, where a sharp tonal change occurs at the lineation.

The spring Jacob's Well, which is caused by the fault, flowed about 1100 gallons per minute when its discharge was measured in 1955 (DeCook, 1963, p. 57). Increased rainfall in recent years has probably increased this flow somewhat. The conduit from which the spring issues is approximately 110 feet deep, but its actual length is greater than that because it extends horizontally about as far as it is deep and it is somewhat sinuous. The width of the well at the surface is about 10 feet and the conduit remains wide enough downward to permit entry of scuba divers all the way to the bottom. Photographs of fretted walls inside the well indicate that solution is still active. The source of the water issuing from the spring is ground water which flows down-dip through

Figure 9.

Outcrops of Jacob's Well Fault

The upper print is a southwest view showing Member D faulted against Member B. The photo was taken on an unnamed hill about 0.5 miles southwest of the intersection of Jacob's Well Road and Texas FM 12.

The lower print is a northeast view of Jacob's Well fault showing slight fault drag on the upthrown side of the fault and several blocks that were detached from the upthrown side of the fault and dragged downward slightly. Most of the displacement occurred on a surface just to the right of the "dragged blocks." The photo was taken across Cypress Creek where the creek crosses the fault.

the cavernous limestones of Member A. This water meets an impermeable barrier at Jacob's Well fault, where the marls and thin limestones of Member B are faulted down into contact with Member A. The water does not flow to the surface along the fault plane but rises instead about 300 yards updip from it, possibly because fractures associated with the fault provided a channel early in the history of the spring.

Tom Creek Fault: Tom Creek fault was named by W. O. George (1952, p.52) for Tom Creek, a tributary to the Guadalupe River in Comal County. Tom Creek fault in the Wimberley area begins where it branches from Lone Man fault and progresses southwestward, passing just northwest of Little Twin Sisters Peaks and leaving the thesis area on the west along Cloptin Road.

The trace of Tom Creek fault, like that of Jacob's Well fault, is slightly irregular and serrate but its general trend is about N35°E. Displacement is downward to the southeast and ranges from about 130 feet on the unnamed hill southwest of the Jacob's Well Road—Texas F.M. 12 intersection to about 100 feet southwest of Little Twin Sisters Peaks. Well exposed outcrops of Tom Creek fault are rare.

Wimberley Fault: The Wimberley fault was named by DeCook (1963, p. 46) for the community of Wimberley. The fault is composed of two segments, a short eastern segment having a bearing of N40°E and a much longer western segment that has a bearing of about N53°E in the northeast and approximately N43°E in the southwest. The eastern segment crosses the eastern boundary of the area approximately one mile northeast of Wimberley and continues southwest about ½ mile and then "splays out" into three segments and becomes covered by alluvium of Cypress Creek. Although the fault is not mapped beyond Wimberley, a small displacement extension of it may continue for as much as another mile to the southwest, as indicated by the anomolous northeast course of the Blanco River and by slightly dipping strata that were observed in the bed of the river about ¾ mile southwest of the community.

The longer, western segment of the fault begins a short distance north of the eastern segment and trends southwestward, passing near Pioneer Town and leaving the area about ½ mile north of the Devil's Backbone. Displacement on the fault is downward to the southeast and amounts to about 100 feet in the vicinity of Cloptin Road and

approximately 120 feet near the western margin of the area. The fault crops out near the mouth of Smith Hollow Creek, where its apparent dip is about 80° southeast.

Devil's Backbone Fault: The Devil's Backbone fault is named here for the Devil's Backbone, a high relief ridge forming the sharp divide between the drainage basins of the Blanco and Guadalupe Rivers on the western margin of the thesis area. The fault trends generally N80°E across the entire width of the area in the vicinity of Texas F.M. 32. The fault trace is, however, very irregular and serrate and its trend ranges from N58°E to N80°W. The Bee Cave-Edwards contact is displaced downward to the south about 60 feet. The fault appears to be a cross-fault between Hidden Valley fault and Wimberley fault.

Hidden Valley Fault: Hidden Valley fault was named by George (1952, p. 31). Only a short segment of this fault is present in the Wimberley area, transecting the southeast corner of the area at a bearing of about N50°E. Lack of stratigraphic control prevented determination of the displacement of the fault, but it was estimated by George (1952) to be about 200 feet. No outcrops of the fault were observed in the Wimberley area.

Minor Faults

Poppy Ranch Fault: The Poppy Ranch fault is named for the ranch in the thesis area on which most of its length is located. The fault enters the area from the northeast approximately ½ mile south of Lone Man fault and dies out about ¾ mile to the southwest. The trend of the fault is about N55°E and its displacement is downward to the southeast, ranging from zero at its southwest end where it dies out to a minimum of 35 feet at the eastern margin of the area. This fault is closely related to the much larger displacement Lone Man fault and probably branches from it east of the thesis area.

Eagle Rock Ranch Fault: Eagle Rock Ranch fault, like the Poppy Ranch fault, is named for the ranch on which most of its length is located. The fault branches from Lone Man fault and is about 2¾ miles long. It is connected to Tom Creek fault by a short cross fault a short distance west of Texas F.M. 12. The segment of the fault northeast of the short cross-fault differs from other faults in the area in being downthrown to the northwest. The fault block between Lone Man fault and this northeast segment of Eagle Rock Ranch fault is a small graben. Southwest of the cross-fault, displacement on the

fault is normal; that is, downward to the southeast.

Displacement on the fault is variable and could not be determined because fault block dip on the southeast side of the fault is too great to provide stratigraphic control. A good outcrop of the fault occurs at the top of a small hill a short distance northeast of the point where the fault is crossed by Texas F.M. 12.

Unnamed faults: Two short, unnamed, small-displacement faults are located northwest of Jacob's Well fault near the western margin of the thesis area. The average trend of the northern fault is about N75°E and the southern fault bears about N52°E. The two faults converge at their northeast ends. Displacement on each of the faults is about 20 feet downward to the southeast.

Joints

Several sets of vertical joints were observed in the Wimberley area, but a rigorous statistical analysis of them is beyond the scope of this study. Consequently no attempt was made to collect systematic joint data or to relate the joints to faulting in the area. Davis (1962) collected joint data in a quadrangle 5 miles east of the Wimberley area and found two pairs of joint sets. One pair trended northeast and northwest and were interpreted to be tension joints related to Balcones faulting. The other pair trended north-south and east-west and were interpreted to have formed before Balcones faulting.

The few joint data collected in the Wimberley area are shown in Plate 1. Almost all of the joints trend either northeast or northwest and, like those in Davis' area, are probably related to the Balcones faults in the area.

Regional and Fault Block Dip

The regional dip northwest of Jacob's Well fault, as determined by the three point method, is 19 feet per mile in a S70°E direction. The two fault blocks between Jacob's Well and Tom Creek faults and between Tom Creek and Wimberley faults are also tilted to the southeast, but apparently at a slightly greater angle then the regional dip angle. The strata between Wimberley fault and Hidden Valley fault appear to dip southeast at about the angle of regional dip. The dip southeast of Hidden Valley fault is not known.

GEOMORPHOLOGY

Edwards Plateau

The Wimberley area, as previously stated, is situated on the dissected eastern margin of the Edwards Plateau. The boundary between the plateau and the Gulf Coastal Plain lies at the main Balcones fault line scarp about seven miles southeast of the thesis area. The Edwards Plateau is a stripped structural surface from which strata overlying the resistant Edwards formation were removed before the plateau was uplifted to its present height (Fenneman, 1936). The eastern margin of the plateau is presently being actively eroded and dissected, as indicated by its high relief and rugged topography. Evidence of this dissection can be seen in the Wimberley area in the high relief hills and ridges along the southern drainage basin of the Blanco River and in the high rounded hills such as Lone Man and Lone Woman Mountains and Little Twin Sisters Peaks, which are erosional remnants of the plateau surface.

Drainage Characteristics

The drainage in some parts of the Wimberley area displays pronounced structural control. This control is manifested in two ways: (1) by the drainage pattern of streams in some sections of the area, which is probably controlled by jointing, and (2) by deflections of individual streams, which are caused by faults.

Drainage patterns: The streams north of Cypress Creek have a strong preferred north-south alignment that is probably controlled by jointing. The Blanco River and its tributaries in the southern part of its drainage basin exhibit a dominant northeast orientation which is no doubt related to joints and very small displacement faults associated with Wimberley fault. The streams between Cypress Creek and the Blanco River and those in the area south of the southern drainage divide of the Blanco do not appear to display any preferred orientations.

Fault deflections: Cypress Creek is deflected sharply to the southwest from its general southeast course in two places where it crosses major faults. The first deflection occurs approximately one mile north of Little Twin Sisters Peaks where the creek crosses Tom Creek fault and the second is a short distance north of Wimberley, where the creek crosses Wimberley fault. The second deflection causes the creek to make a peculiar

hook-like bend shortly before it flows into the Blanco River. The Blanco, where it enters the Wimberley area from the west, changes from its normal southerly and easterly course and flows generally northeast across the area because of control by Wimberley fault and associated small-displacement faults.

Minor Geomorphic Features

Terraced topography: Members B through G of the Glen Rose Formation, where relief is moderate to steep, weather to a distinctive terraced topography that is characteristic of the Glen Rose Formation and is used extensively in the central Texas region for identifying the formation in the field (Figure 10). The terraces are caused by differential weathering of the nearly horizontal, thin to thick bedded strata of the formation.

Caves: Several caves, some of which are shown on Plate 1, are present in the Wimberley area. The caves are almost exclusively confined to two stratigraphic units, the Edwards Formation and Member A of the Glen Rose Formation, possibly because the clay content of the other units in the thesis area is too high to permit solution and cave development. No sinkholes were observed in the area.

Surficial solution features: Abundant surficial solution features were observed in the Wimberley area in the form of *lapiés* or *karren* which occur mostly on the Edwards Formation in the upland areas, and tinajitas (Udden, 1925), which were seen only in the vicinity of the Blanco River (Figure 11).

Corrasion grooves: Corrasion grooves (King, 1927) are abundant in the Blanco River and they also occur above the present bed of the river on strata that the river formerly flowed on. These emergent grooves are presently being converted into tinajitas.

Figure 10.

Terraced Topography

Northeast view showing characteristic "terraced" topography of the Glen Rose Formation. Three terraces can be seen. The photo is of Member D and was taken in the northern part of the thesis area.

Figure 11.

Tinajita

View showing the characteristic flat bottom and overhanging sides of a tinajita. The photo was taken near the bed of Blanco River at about the north-south median of the thesis area.

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APPENDIX

INTRODUCTION

The lithologic descriptions given in this appendix refer to stratigraphic sections measured and described in the Wimberley area. The entire Cretaceous section exposed in the area, except the uppermost 46 feet, was measured and described. The weathering profiles, fossil content, lithologies, and correlations of the measured sections appear in Plate 2 (in pocket), where the measured section numbers and bed numbers correspond to those used here. The locations of those measured sections that are situated within the bounds of the thesis area are shown on Plate 1 (in pocket). A brief description of the locations of the measured sections appears at the beginning of each of the section descriptions.

These descriptions are a synthesis of descriptions made in the field using a 10X hand lens and descriptions of samples that were collected in the field, taken to the laboratory, sawed into slabs, etched with dilute (10%) hydrochloric acid, and examined with the aid of a binocular microscope having up to 60X magnification. Hence, those beds from which a sample was collected are described more completely and in greater detail than the beds from which no sample could be obtained. Sample collection points are shown in Plate 2.

Dolomite in particular is more clearly seen in the etched slab with a microscope than in small hand specimens in the field. Thus, beds from which a sample was taken that are recorded as dolomitic would possibly not have been called dolomitic had they been described only in the field. No insoluble residue studies were made, and consequently the presence of clay is often not noted except as implied in the use of the term "marl." Clay is, however, noted in several beds as "terrigenous clay."

The relative abundance of the constituents of the strata are noted by the following terms, which are listed in order of increasing abundance:

1. Rare — only 1 or two examples observed.
2. Occasional — several examples are present and are seen with moderate search effort.
3. Frequent — several examples are present and are seen with very little search effort.

4. Abundant – numerous examples are present and constitute up to 1% of the rock volume.
5. Very abundant – examples constitute 1-5% of the rock volume.
6. Extremely abundant – examples constitute 5-25% of the rock volume.

The percentages given in the descriptions, unless otherwise noted, refer to percentages of the total allochem portion of the rock.

The rock properties that are described, in the approximate order that they appear in the descriptions, are as follows:

1. Bed thickness
2. General rock name
3. Folk classification (1962) name
4. Allochem grain size
5. Allochem descriptions
6. Fossil content
7. Dolomite content
8. Crystal size of dolomite
9. Structures
10. Porosity
11. Hardness
12. Bedding characteristics
13. Fresh and weathered color
14. Extent of cover or calichification

Some of the above properties are deleted from some of the bed descriptions because they are not applicable or are not determinable.

Bed thickness: Bed thicknesses accurate to the nearest one-tenth foot are recorded.

General rock name: Three terms are used for general rock names: limestone, marl, and dolomite. If a bed is composed of two or all three of the rock types, the terms are combined.

"Limestone" is used for beds that have "normal" limestone textures; that is, a combination of allochems, micrite, and sparry calcite in varying proportions. "Marl" is a field term applied to poorly resistant, usually nodular beds (e. g. Figure 8 in text) that contain varying amounts of terrigenous clay. Although it is generally accepted that the difference between the weathering character of marls and limestones is caused by a higher clay content in the marls, the difference is probably more closely related to the

distribution of the clay within the bed; that is, the clay is homogeneously distributed throughout resistant limestone beds, but in the less resistant marls it is confined to very thin (less than 1 mm.) undulatory bands or laminae separated by equally thin bands of carbonate (R. L. Folk, personal communication).

"Dolomite" refers to soft, brown, saccharoidal, generally black or dark gray weathering (the latter probably caused by lichens) strata that were probably originally deposited as limestone-forming material but were subsequently dolomitized by a process not yet completely understood. Most of these beds display at least some trace of relict limestone texture.

Limestones that are partially dolomitized are called "dolomitic limestones" if they are less than 50% dolomite or if they clearly display limestone textures. Strata that are more than 50% dolomite or have their limestone textures mostly effaced by dolomitization are referred to as "calcareous dolomites." "Marly limestones" are rocks that are transitional in composition and weathering character between marls and limestones.

Folk classification name: Folk's limestone classification (1962) is used to classify the limestones, the marls, and those dolomites that retain enough relict texture for approximate classification. The term "muddy" is used in place of Folk's "poorly washed" because it is shorter and more descriptive.

Allochem grain size: The Wentworth grain size scale is used to classify allochem grain size.

Allochem descriptions: The type of allochems present, which is indicated in the Folk classification name, is elaborated, and the shape, rounding, and sorting of the allochems are noted. Fragmented fossil allochems are referred to as "biogenic allochems." The presence of coated grains (superficial oölites) is noted and, where possible, the composition of intraclasts is given.

Fossil content: The presence or abundance of identifiable fossils is noted in this section. The fossils described here are distinguished from biogenic allochems, which are described in the previous section, because they are identifiable, although in some cases no lower than the phylum level.

Dolomite content: This section describes the presence or abundance of dolomite in limestones or marls.

Crystal size of dolomite: The size of dolomite crystals in dolomites and dolomitic limestones is noted here. Most of the dolomites of the Glen Rose are medium crystalline (0.0625-0.25 mm.), but some are finely crystalline (0.0156-0.0625 mm.).

Structures: Those features of the strata that are of the next higher order of complexity than the textures are described here. Examples of the features recorded are cross bedding, burrowing, and "honeycomb structure." Honeycomb structure is a feature of burrowed limestones from which the burrow fill has weathered out leaving a complex of interconnected chambers of varying sizes. The resulting rock superficially resembles a honeycomb from a natural bee hive.

Porosity: The porosity of limestones, when it is present, is usually intergranular and that of dolomite is intercrystalline or has resulted from the leaching out of calcareous allochems. The amount of porosity is indicated by the terms very low, low, moderate, high, and very high or it is given as an approximate percentage of the total rock volume.

Hardness: The hardness of a stratum is indicated by the following terms, which are listed in order of increasing hardness:

1. Very soft
2. Soft
3. Moderately soft
4. Moderately hard
5. Hard
6. Very hard

Bedding characteristics: The bedding terms used in the descriptions are shown below with their approximate thickness equivalents:

1. Very thin bedded – less than 1/4" thick
2. Thin bedded – 1/4" to 2" thick
3. Medium bedded – 2" to 1' thick
4. Thick bedded – 1' to 3' thick
5. Very thick bedded – more than 3' thick

In addition to these, the terms massive and nodular are used. Massive indicates that no bedding planes were observed between the upper and lower contacts of the bed. Nodular

is used to refer to a lumpy, irregular weathering character that can be seen in Figure 4 of the text.

Fresh and weathered color: Since color is neither an invariable property of a bed nor a diagnostic rock feature, only general color terms, such as buff, tan, and light, medium, and dark gray, were used to describe the samples. The Geological Society of American Rock Color Chart equivalents of buff and tan, the two most commonly used terms, are, respectively, very pale orange (10YR8/2) to pale yellowish orange (10YR8/6) and grayish orange (10YR7/4) to dark yellowish orange (10YR6/6).

Extent of cover and calichification: If a bed is calichified or partially covered, its description is not as complete or as accurate as the descriptions of well exposed and unaltered beds. The extent of these limiting factors are the last property of the strata that is described.

MEASURED SECTION 1.

Measured Section 1 is on a cut bank of Bee Cave Creek approximately 1/2 mile northwest of the intersection of Jacob's Well and Mount Sharp Roads.

1. —— Limestone: sparse biomicrite; medium to very coarse; 5% randomly oriented platy shell allochems; very abundant oyster fragments; abundant serpulids; hard; massive; buff; weathers grayish-brown.

2. 0.6′ Limestone: packed biomicrite; fine to very coarse; 1-2% platy shell allochems; 5-10% reddish-brown stained allochems; frequent crab fragments; moderately hard; massive; tan to brown; weathers grayish brown.

3. 1.1′ Limestone: packed biomicrite; very fine to granular; well rounded allochems; 10-20% randomly oriented platy shell allochems; frequent well rounded intraclasts; frequent coated grains; abundant serpulids; very abundant oyster fragments; extremely abundant crab fragments; occasional medium pebble size clam steinkerns; occasional miliolids and other foraminifers; hard; massive; buff; weathers medium gray.

4. 2.2′ Limestone: sparse biomicrite; fine to very coarse; 5% randomly oriented platy shell allochems; rare crab fragments; occasional oyster fragments; frequent *Orbitolina* sp. in upper one-fourth; hard; slightly nodular; weathers dark gray.

5. 2.2′ Limestone: sparse biomicrite; very fine to granular; 30% randomly oriented platy shell allochems, occasional well rounded intraclasts; abundant *Orbitolina* sp.; abundant miliolids and other foraminifers; occasional serpulids; occasional crab fragments; hard; massive; buff; weathers medium gray.

6. 1.2′ Limestone: packed biomicrite; fine to very coarse; 5% randomly oriented platy shell allochems; abundant *Orbitolina* sp.; hard; massive; tan; weathers dark gray.

7. 0.7′ Dolomitic limestone: packed biomicrite; fine to very coarse; frequent biomicrite intraclasts; 1-2% platy shell allochems; well rounded allochems; occasional hematite spots; micrite matrix completely replaced by dolomite; abundant *Orbitolina*; abundant miliolids and other foraminifers; occasional oyster fragments; hard; massive; buff; weathers dark gray.

8. 0.5′ Dolomitic limestone: muddy *Orbitolina* sp. intraclastic biosparite; very fine sand to small pebble size; rounded intraclasts; spar cement partially dolomitized; rare pseudomorphs of hematite after pyrite; very abundant *Orbitolina* sp.; occasional pectins and *Tylostoma* sp.; abundant oyster fragments; hard; massive; tan; weathers light reddish-brown.

9. 0.8' Extremely dolomitic limestone: packed *Orbitolina* sp. biomicrite; fine to granular; occasional rounded biomicrite intraclasts; micrite matrix completely dolomitized; very abundant randomly oriented *Orbitolina* sp.; frequent oyster shells; very porous; laminated; moderately hard; massive; light gray; weathers medium gray.

10. 1.8' Limestone: packed biogenic intramicrite; very fine to granular; 60% randomly oriented platy shell allochems; intraclasts range in composition from packed biomicrite to biosparite; most intraclasts are laminated and are oriented at angles up to 30° to bedding; 5% reddish-brown stained allochems; extremely abundant *Orbitolina* sp.; occasional serpulids; abundant miliolids; occasional crab fragments; occasional oyster fragments; occasional pelecypod steinkerns; single pectin noted; hard; massive; buff; weathers medium gray.

11. 0.3' Limestone: packed biomicrite; fine to granular; larger allochems are well rounded; 5% randomly oriented platy shell allochems; faintly laminated; moderately hard; grayish-tan; weathers dark gray.

12. 5.5' Limestone: packed biomicrite; fine to very coarse; 10% randomly oriented platy shell allochems; becomes coarser grained and less muddy upward to muddy biosparite; very hard; massive; buff; weathers medium gray.

13. 3.5' Limestone: packed biomicrite; fine to coarse; occasional oyster fragments; hard; massive; tan; weathers medium gray.

14. 1.1' Limestone: sparse biomicrite; fine to coarse; abundant *Orbitolina* sp. at top; occasional oyster fragments; single large *Turitella* sp. noted; moderately hard; nodular; buff; weathers medium gray.

15. 0.3' Limestone: Lower one-half is packed *Orbitolina* sp. biomicrite; very fine to granular; occasional oyster fragments; occasional serpulid fragments; very abundant *Orbitolina* sp.; abundant miliolids and other foraminifers; occasional stromatoporoid fragments; tan to brown. Upper one-half is stromatoporoid biolithite; cellular; abundant pockets of sparse to packed biomicrite; cell voids are spar filled; tan to reddish-brown; hard; massive; weathers medium gray.

16. 1.7' Limestone: packed intraclastic biomicrite; fine to granular; abundant intraclasts of very muddy biosparite; occasional *Orbitolina* sp.; moderately hard; lumpy; buff; weathers medium gray.

17. 2.0' Limestone: packed biomicrite to very muddy biosparite; fine to granular; very argillaceous at base; rare crab fragments; moderately hard; weathers nodular; buff to tan; weathers medium to dark gray.

18. 1.9' Limestone: packed biogenic intramicrite; very fine sand to small pebble size; 5-10% light yellow-brown stained allochems; occasional oyster fragments;

abundant small pebble size intraclasts, mostly well rounded and light yellow-brown stained; occasional miliolids; rare *Orbitolina* sp.; rare serpulids; hard; buff; weathers medium gray.

19. 6.2′ Limestone: sparse biomicrite; fine to coarse; occasional miliolids; moderately hard; nodular; buff; weathers light gray; mostly covered.

20. 8.2′ Dolomitic limestone: packed biogenic intramicrite; very fine sand to small pebble size; abundant coated grains; intraclasts are well rounded and 60% are light yellow-brown stained; micrite matrix almost completely replaced by dolomite; occasional miliolids and other foraminifers; frequent serpulids at base; rare medium pebble size clam impressions; hard; massive; buff to tan; weathers medium gray.

21. 8.3′ Dolomitic limestone: sparse to packed biomicrite; very fine to coarse; frequent randomly oriented platy shell allochems; very dolomitic micrite matrix; original limestone texture badly effaced by dolomitization; abundant miliolids and other foraminifers; rare *Orbitolina* sp.; occasional crab fragments at top; moderately porous; hard; massive; buff; weathers medium gray.

22. 19.3′ Limestone: fossiliferous micrite to sparse biomicrite; fine to coarse; becomes slightly dolomitic upward; occasional miliolids; occasional serpulids at base; occasional crab fragments near middle; occasional clam impressions; hard; massive; buff to grayish-brown; weathers medium gray.

23. 5.9′ Very dolomitic limestone: packed biomicrite; very fine to coarse; abundant reddish-brown hematite spots; frequent miliolids and other foraminifers; single large wood fragment noted; occasional *Porocystis globularis,* original limestone texture partially effaced by dolomitization; faintly laminated; hard; massive; buff; weathers dark gray; mostly covered in lower half.

24. 5.0′ Dolomitic limestone: sparse to packed biomicrite; very fine sand to small pebble size; occasional randomly oriented platy shell allochems; frequent miliolids and abundant miliolid fragments; single large pebble size pelecypod noted; very dolomitic; original limestone texture partially effaced by dolomitization; moderately porous; very hard; massive; buff to tan; weathers medium to dark gray.

25. 1.3′ Limestone: sparse biomicrite; fine to very coarse; 5% fine light yellow-brown stained allochems; occasional platy shell allochems oriented parallel to bedding; rare miliolids; faintly laminated; hard; flaggy; tan; weathers medium to dark gray.

26. 6.4′ Dolomitic limestone: packed biomicrite; very fine to granular; occasional oyster fragments; frequent randomly oriented platy shell allochems; 5% light yellow-brown stained allochems; abundant miliolids and other foraminifers; very dolomitic; original limestone texture partially effaced by dolomitization; slightly burrowed with small diameter burrows; very hard; massive; buff to tan; weathers medium gray.

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27. 2.2′ Marl: sparse to packed biomicrite; fine to very coarse; very abundant *Monopleura* sp.; occasional miliolids; occasional *Tousasia* sp.; occasional snails; moderately soft at base to moderately hard at top; thin nodular bedded; tan; weathers medium gray.

28. 0.8′ Marly limestone: packed biomicrite; fine to coarse; 1-2% light yellow-brown stained allochems; rare miliolids; slightly dolomitic; moderately hard; massive; tan; weathers dark gray.

29. 1.1′ Extremely dolomitic limestone: packed biomicrite; very fine to granular; abundant miliolids and other foraminifers; abundant small clam impressions; dolomitic; micrite matrix completely replaced by dolomite; moderately porous; tan; weathers black.

MEASURED SECTION 2.

Measured Section 2 is near the northwest corner of the thesis area on the east side of the valley of one of the tributaries of Cypress Creek.

1. —— Extremely dolomitic limestone: sparse to packed biomicrite; very fine to coarse; frequent miliolids and other foraminifers; single echinoid plate noted; frequent reddish-brown hematite spots; micrite matrix completely dolomitized; original limestone texture partially effaced by dolomitization; medium crystalline dolomite; faintly laminated; hard; massive; buff; weathers medium gray.

2. 2.7′ Dolomitic limestone: fossiliferous micrite; fine to coarse; 2-3% light yellow-brown stained allochems; occasional miliolids; dolomitic; hard; massive; weathers medium gray.

3. 5.0′ Dolomitic limestone: sparse to packed biomicrite; very fine sand to small pebble size; occasional randomly oriented platy shell allochems; 5% light yellow-brown stained allochems; abundant miliolids; abundant *Toucasia* sp., apparently in patch reefs; abundant oyster shells; abundant reddish-brown hematite spots; moderately dolomitic at base to extremely dolomitic at top; micrite matrix completely dolomitized; original limestone texture partially effaced by dolomitization; medium crystalline dolomite; moderately porous; hard; massive; tan; weathers medium gray.

4. 2.1′ Limestone: packed foraminifer biomicrite; fine to coarse; extremely abundant miliolids and other foraminifers; very abundant rudists in patches, mostly *Toucasia* sp. with occasional *Monopleura* sp.; hard; massive; tan; weathers medium gray.

5. 2.0′ Extremely dolomitic limestone: sparse to packed miliolid biomicrite; fine sand to small pebble size; 2-3% randomly oriented platy shell allochems; extremely dolomitic; micrite matrix completely replaced by dolomite; medium crystalline dolomite; very porous; very abundant rudists in patches, especially at top; occasional small clam impressions noted; slightly burrowed; hard; massive; buff to tan with yellow-brown burrow fill; weathers light gray.

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6. 2.0′ Dolomitic limestone: sparse to packed biomicrite; fine sand to small pebble size; frequent thick-walled pelecypod fragments; abundant miliolids and other foraminifers; abundant *Toucasia* sp.; occasional *Monopleura* sp.; extensively dolomitized; original limestone texture partially effaced by dolomitization; medium crystalline dolomite; slightly porous; moderately hard; slightly nodular; light tan; weathers buff to medium gray.

7. 1.0′ Dolomitic limestone: packed biomicrite; fine to very coarse; frequent miliolids; frequent granular to small pebble size *Toucasia* sp. fragments; moderately hard; slightly nodular; tan; weathers buff.

8. 4.0′ Marly limestone: packed biogenic intramicrite; fine sand to small pebble size; intraclasts range in composition from fossiliferous micrite to packed biomicrite; intraclasts are angular and yellow to yellowish-brown; frequent coated grains; abundant randomly oriented platy shell allochems; abundant miliolids and other foraminifers; occasional serpulid fragments; abundant oyster fragments; rare snails; frequent reddish-brown hematite spots; moderately hard; becomes more resistant upward; nodular; grayish tan; weathers medium gray.

9. 0.5′ Limestone: sparse to packed biogenic intramicrite; fine to granular; well rounded intraclasts; occasional oyster fragments; abundant miliolids and other foraminifers; frequent reddish-brown stained hematite spots; very dolomitic in upper portion; medium crystalline dolomite; hard; tan to yellowish brown; weathers buff.

10. 10.5′ Covered. No description.

11. 1.8′ Limestone: packed biomicrite; fine to granular; 10% randomly oriented platy shell allochems; abundant small to large pebble size clam impressions; occasional *Nerinea* sp.; moderately hard; massive; buff to tan; weathers medium gray.

12. 2.0′ Dolomitic limestone: packed intraclastic biomicrite; very fine to granular; 30% randomly oriented platy shell allochems; 15% very coarse to granular well rounded intraclasts; occasional *Orbitolina* sp.; rare serpulids; occasional thick-walled pelecypod fragments; frequent miliolids and miliolid fragments; very dolomitic; micrite matrix completely replaced by dolomite; medium crystalline dolomite; low leached allochem porosity; hard; massive; buff; weathers medium gray.

13. 2.0′ Dolomitic limestone: packed biomicrite; fine sand to small pebble size; abundant *Monopleura* sp. near base, decreasing in abundance upwards; occasional reddish-brown hematite spots; very dolomitic; micrite matrix almost completely replaced by dolomite; medium crystalline dolomite; moderately porous; hard; buff; weathers medium gray.

14. 0.7′ Limestone: packed biomicrite; fine to very coarse; 10% randomly oriented platy shell allochems; occasional miliolids; rare serpulids; abundant Monopleura sp.; hard; massive; buff; weathers medium gray.

15. 0.3′ Limestone: slightly muddy biosparite; medium to very coarse; poorly sorted; abundant miliolids and other foraminifers; very hard; massive; buff; weathers medium gray.

16. 0.4′ Limestone: slightly muddy miliolid biosparite; fine to very coarse; 3% platy shell allochems oriented parallel to bedding; occasional intraclasts; 20% miliolids and other foraminifers; moderately burrowed with dolomitic biomicrite burrow fill; medium crystalline dolomite; very hard; massive; light brown with buff mottles; weathers medium gray.

17. 0.3′ Limestone: packed biomicrite; medium to granular; 40% randomly oriented platy shell allochems; very hard; massive; tan; weathers medium gray.

18. 0.4′ Limestone: muddy biosparite; fine to granular; extremely abundant reddish-brown stained hematite spots; extremely abundant spherical micrite filled organic allochems, probably ostracods; abundant miliolids and other foraminifers; reddish-brown; weathers light brown to medium gray.

19. 3.2′ Marl: packed biomicrite; medium to very coarse; moderately soft; buff; weathers tan; partially covered and calichified.

20. 0.2′ Limestone: sparse to packed biomicrite; fine to granular; 70-80% randomly oriented platy shell allochems; occasional miliolids; occasional spar filled fractures indicate dismicrite structure; frequent reddish-brown hematite spots; micrite content increases upward to fossiliferous micrite; many shell allochems replaced by hematite; tan to reddish-brown; weathers light gray.

21. 2.7′ Dolomitic marl: sparse biomicrite; fine to very coarse; 1-2% very coarse randomly oriented platy shell allochems; dolomitic; moderately soft; buff; weathers buff; partially covered and calichified.

22. 9.6′ Marl: mostly covered and calichified; upper one foot indicates fossiliferous micrite; medium to coarse; very soft; very thin flaggy bedded; reddish-brown; weathering color indeterminable.

23. 0.4′ Limestone: packed biomicrite; fine to very coarse; 50% platy shell allochems oriented parallel to bedding; 70-80% coated grains; 5% reddish-brown stained allochems; abundant miliolids and other foraminifers; faintly laminated; weathers flaggy; hard; tan to light brown; weathers reddish-brown.

24. 1.5′ Limestone: extremely muddy biosparite; fine to very coarse; 10% randomly oriented platy shell allochems; occasional reddish-brown hematite spots; frequent miliolids and miliolid fragments; occasional serpulids; occasional crab fragments; very abundant small to medium pebble size clam steinkerns; frequent gastropods; moderately burrowed; hard; massive with slight honeycomb structure; buff; weathers medium gray.

25. 2.2′ Limestone: packed intraclastic biomicrite; medium to granular; 15% platy shell allochems oriented parallel to bedding at base and randomly oriented at top; massive; becomes flaggy bedded upward; moderately burrowed at top causing slight honeycomb structure; hard; tan; weathers medium gray.

26. 3.2′ Marly limestone: sparse biomicrite; fine to coarse; 1-3% randomly oriented platy shell allochems; 5% light yellow-brown stained allochems; occasional small to medium pebble size thick walled pelecypod fragments; very dolomitic; moderately hard; slightly nodular; tan; weathers medium gray.

27. 8.5′ Marl: badly covered; upper one foot indicates packed biomicrite; fine to very coarse; very abundant *Nerinea* sp.; abundant small to medium pebble size oyster fragments; very abundant *Orbitolina* sp.; frequent small to large pebble size pelecyod steinkerns; occasional crab fragments; moderately soft; nodular; buff; weathers medium gray. This bed is the "*Salenia texana* marl."

28. 0.8′ Limestone: packed biomicrite; fine to very coarse; frequent small to medium pebble size clam steinkerns; abundant *Nerinea* sp.; frequent oyster fragments; massive to slightly nodular; moderately hard; tan; weathers medium gray.

29. 2.0′ Slightly dolomitic limestone: sparse to packed biomicrite; fine to granular; abundant granular to medium pebble size well rounded intraclasts; frequent whole and fragmented miliolids and other foraminifers; occasional serpulids; occasional thick walled pelecypod fragments; frequent to abundant crab fragments; single crab claw noted; occasional *Nerinea* sp.; frequent small to large pebble size pelecypod steinkerns; dolomitic, original limestone texture slightly effaced by dolomitization; hard; massive; buff to tan; weathers light gray.

30. 0.2′ Slightly dolomitic limestone: very muddy *Corbula harveyi* biosparite; very fine to granular; abundant *Corbula harveyi* steinkerns; allochems are well rounded; rare *Orbitolina* sp.; occasional miliolids and other foraminifers; occasional thick walled pelecypod fragments; occasional serpulids and serpulid fragments; moderately burrowed with packed biomicrite burrow fill; upper surface is rippled with a wavelength of approximately 1.5′ and an amplitude of 0.21′; very hard; massive; buff to tan; weathers medium gray. This bed is the "*Corbula* bed."

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MEASURED SECTION 3.

Measured Section 3 is about 0.1 mile southwest of the point where Cypress Creek crosses Tom Creek fault.

1. —— Very dolomitic marly limestone: packed biomicrite; very fine to granular; abundant thick walled pelecypod fragments; 10% light yellow-brown allochems; occasional reddish-brown hematite spots; occasional serpulids; abundant miliolids and miliolid fragments; extensively burrowed; very dolomitic; original limestone texture slightly effaced by dolomitization; moderately hard; lumpy; massive; yellow with light reddish-brown mottles; weathers dark gray.

2. 6.1′ Marl: packed biomicrite; very fine to very coarse; 5% randomly oriented platy shell allochems; abundant reddish-brown hematite spots; occasional miliolids; frequent serpulids; very fossiliferous with abundant *Salenia texana, Porocystis globularis, Hemiaster* sp., *Orbitolina* sp., oysters, and "heart clam" steinkerns; occasional *Neithea* sp.; occasional *Tylostoma* sp.; soft; very thin nodular bedded; single medium nodular bedded zone in middle; tan; mottled light brown. This bed is the "*Salenia texana* marl."

3. 1.2′ Marly limestone: sparse to packed *Orbitolina* biomicrite; coarse to granular; 20% platy shell allochems; 10% light brown stained allochems; abundant *Orbitolina* sp.; occasional medium pebble size "heart clam" steinkerns; occasional *Hemiaster* sp.; single *Salenia texana* spine noted; occasional oyster fragments; occasional *Nerinea* sp.; moderately burrowed; moderately hard; lumpy; yellow-brown with light brown mottles; weathers buff to white.

4. 1.5′ Very dolomitic limestone at base to limestone at top: packed biomicrite at base to muddy biosparite at top; very fine to granular; occasional coated grains; 5% well rounded intraclasts ranging in composition from sparse to packed biomicrite to very muddy biosparite; abundant randomly oriented platy shell allochems; 10% light brown allochems; occasional reddish-brown hematite spots; frequent *Orbitolina* sp.; abundant miliolids and other foraminifers; frequent serpulids; very dolomitic at base to slightly dolomitic at top; medium crystalline dolomite; original limestone texture slightly effaced by dolomitization; slightly porous; very hard; buff to light reddish-gray; weathers grayish brown.

5. 0.3′ Limestone: muddy *Corbula harveyi* biosparite; fine sand to small pebble size; extremely abundant reddish-brown hematite spots; extremely abundant coated grains; abundant miliolids and other foraminifers; extremely abundant micrite filled *Corbula harveyi* casts; *Corbulas* are oriented with long dimension parallel to bedding; 10% of the *Corbulas* are spar filled; occasional geopetal structures; faintly laminated; very hard; light brown to tan; weathers reddish-brown; upper surface is rippled with a wavelength of approximately 1.3′ and an amplitude of

approximately 0.2′; bearing of the ripple crests is approximately N75°E. This bed is the "*Corbula* bed."

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6. 0.4′ Limestone: packed biomicrite to slightly muddy biosparite; fine sand to small pebble size; abundant randomly oriented platy shell allochems; occasional reddish-brown hematite spots; very abundant *Corbula harveyi* steinkerns; approximately 10% of the *Corbulas* are spar filled; occasional serpulids; faintly bedded; reddish-brown; weathers dark reddish-brown.

7. 0.7′ Marly limestone: very muddy biosparite; fine sand to small pebble size; 2-3% platy shell allochems; occasional *Corbula harveyi* at base to very abundant at top; moderately soft; thin bedded; apparently slightly argillaceous; light yellow-brown.

8. 4.6′ Marl: calcareous mudstone; allochem content increases toward top; occasional oyster fragments and *Corbula* at top; apparently extremely argillaceous; very soft; very thin bedded; light yellow-brown; weathers light yellow-brown to medium gray, partially calichified.

9. 0.5′ Limestone: very muddy *Corbula harveyi* biosparite to packed *Corbula harveyi* biomicrite; very fine sand to small pebble size; up to 60% platy shell allochems oriented parallel to bedding; abundant reddish-brown stained hematite spots; occasional miliolids and miliolid fragments; dolomitic with medium crystalline dolomite; upper part is extremely vuggy with vugs ranging in size from 1/8—1″ vugs probably caused by dissolved evaporites; well laminated; very hard; thin marly zone in middle; tan.

10. 4.5′ "Evaporite" bed: composed mostly of sparry calcite veins; shows some evidence of "distorted bedding" and collapse features, indicating it was originally deposited as an evaporite, and the evaporite minerals have been removed by solution.

11. 2.7′ Marly limestone: sparse to packed biomicrite; fine to very coarse; 10% platy shell allochems oriented parallel to bedding, giving the rock a laminated appearance; abundant well rounded intraclasts; probably an intramicrite at base; slightly dolomitic; slight honeycomb structure indicates slight burrowing; very hard; massive; light grayish-tan with tan mottles; weathers light gray.

12. 1.1′ Marl: very calcareous biogenic mudstone; medium to coarse; apparently very argillaceous; soft; thin bedded; tan; weathers black.

13. 0.9′ Dolomitic limestone: sparse to packed biomicrite; very fine to coarse; becomes less biogenic upward to fossiliferous micrite; occasional reddish-brown

hematite spots; occasional to abundant miliolids and miliolid fragments; very dolomitic; micrite matrix completely replaced by dolomite; medium crystalline dolomite; slightly porous; original limestone texture partially effaced by dolomitization; moderately burrowed with packed biomicrite burrow fill; faintly laminated; hard; massive at base; thin to medium flaggy bedded at top; buff to light gray; weathers dark gray.

14. 1.5′ Dolomitic limestone: sparse to packed biomicrite; very abundant randomly oriented platy shell allochems; very abundant oyster fragments at top; 10% light yellow-brown allochems; abundant miliolids and miliolid fragments; moderately dolomitic; medium crystalline dolomite; original limestone texture slightly effaced by dolomitization; moderately burrowed with packed biomicrite burrow fill; apparently very argillaceous; moderately soft; thin nodular bedded; tan; weathers light brown.

15. 2.3′ Marly limestone: packed biogenic intramicrite to packed biomicrite; very fine sand to small pebble size; abundant coated grains; intraclasts are well rounded and range in composition from micrite to packed biomicrite to muddy biosparite with coated grains; 60% of the allochems are well rounded; 5-10% randomly oriented platy shell allochems; frequent reddish- to yellowish-brown hematite spots; rare glauconite grains in lower part; rare to abundant miliolids and other foraminifers; abundant cellular thick walled pelecypod fragments; slightly dolomitic with floating medium crystalline dolomite rhombs; moderate burrowing indicated by fossiliferous micrite patches within packed biomicrite; hard; massive; buff to tan; weathers dark gray.

16. 4.0′ Marl: very calcareous biogenic mudstone to packed biomicrite; fine to very coarse; 5% platy shell allochems; apparently very argillaceous; abundant very fine to fine reddish-brown hematite spots; slightly dolomitic; moderately soft; very thin bedded to thin nodular bedded; partly calichified.

17. 0.8′ Very dolomitic limestone: packed biomicrite; very fine to granular; 25% platy shell allochems oriented parallel to bedding; abundant miliolids and other foraminifers; very dolomitic; original limestone texture partially effaced by dolomitization; medium crystalline dolomite; slightly porous; hard; medium flaggy bedded; light brown to tan; weathers brown.

18. 1.5′ Extremely dolomitic limestone: fossiliferous micrite to packed biomicrite; medium to very coarse; packed biomicrite patches have 60% platy shell allochems oriented parallel to bedding; very abundant reddish-brown hematite spots; extremely dolomitic; original limestone texture almost completely effaced by dolomitization; medium crystalline; saccharoidal; apparently very argillaceous; soft; massive; tan; weathers black; lower part is calichified.

19. 7.0′ Marl: sparse to packed biomicrite; medium to coarse; apparently very argillaceous; slightly more resistant in middle; very soft; very thin nodular

bedded; tan; weathers light tan to black, calichified near the top where the allochems are leached out.

20. 4.8′ Dolomitic limestone: sparse to packed biomicrite; very fine to granular; frequent randomly oriented platy shell allochems; occasional reddish-brown hematite spots; 5-10% light brown allochems; extremely abundant miliolids in middle; slight to moderate burrowing indicated by honeycomb structure and by mottling; very dolomitic; original limestone texture partially effaced by dolomitization; medium crystalline dolomite; saccharoidal; light yellow-brown to tan with red mottles.

21. 1.5′ Limestone: packed biogenic intramicrite; fine to granular; intraclasts are well rounded and range in composition from fossiliferous micrite to packed biomicrite; many intraclasts contain coated grains; 5% randomly oriented platy shell allochems; abundant prismatic shell allochems; occasional green glauconite grains; occasional pelecypod fragments, some with cellular structure; moderately burrowed with poorly cemented burrow fill; moderate burrowing also indicated by well-developed honeycomb structure; hard; light grayish-brown to reddish-brown; weathers light gray.

22. 0.5′ Marly limestone: packed biomicrite; medium to very coarse; single 3″ vug observed; frequent 1-3″ pelecypod steinkerns; moderately soft; thin nodular bedded; tan; weathers light gray; calichified and leached.

23. 4.2′ Marl: very calcareous mudstone; occasional coarse allochems; apparently very argillaceous; very soft; very thin bedded; tan with medium gray mottles; weathers light gray; partially covered and calichified.

24,.. 0.8′ Dolomitic limestone: sparse to packed biomicrite to very muddy biosparite; fine to granular; 10-20% platy shell allochems oriented parallel to bedding, giving the rock a laminated appearance; frequent miliolids and miliolid fragments; very dolomitic; medium crystalline dolomite; saccharoidal; original limestone texture partially effaced by dolomitization; possible mudcracks at top; moderately burrowed in upper part; flaggy bedded; light brown to tan; weathers tan to light gray.

25. 0.8′ Marl: biogenic very calcareous mudstone; medium to very coarse; apparently very argillaceous; very soft; very thin bedded; tan with medium gray mottles; weathers light tan; calichified.

26. 0.9′ Limestone: packed biomicrite; fine sand to medium pebble size; 10-15% subrounded intraclasts, 20% of which are glauconitic; 30% randomly oriented platy shell allochems; abundant thick shelled pelecypod fragments, some of which are cellular; occasional miliolids and other foraminifers; abundant clams; abundant snails; abundant serpulids; slightly burrowed with poorly cemented burrow fill; very hard; massive; buff; weathers medium gray.

27. 0.9′ Limestone: packed biomicrite; fine to granular; 5% dark gray very coarse sand to granular size possible foraminifer allochems; very hard; massive; buff; weathers medium gray.

28. 1.2′ Marl: sparse biomicrite; fine to medium; apparently very argillaceous; soft; very thin bedded; tan; weathers light tan; calichified and leached.

29. 2.3′ Limestone: packed biomicrite to muddy intraclastic biosparite; fine to very coarse; 15% subrounded small to medium pebble size intraclasts; 60% of the biogenic allochems are coated; biogenic allochems are well rounded; up to 75% platy shell allochems; occasional glauconite grains; frequent miliolids; hard; tan to grayish-tan; weathers medium gray.

30. 1.2′ Marl: sparse biomicrite; fine to very coarse; apparently very argillaceous; very soft; very thin bedded; tan; weathers buff; calichified and leached.

31. 1.0′ Limestone: very muddy biosparite; fine to granular; 50% of the allochems are coated; 50% platy shell allochems oriented parallel to bedding giving the rock a faint laminated appearance; abundant small pebble size intraclasts near middle; very hard; massive; buff; weathers light to medium gray.

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32. 4.5′ Marl: sparse biomicrite; fine to coarse; grades upward into interbedded marl and more resistant biomicrite; apparently very argillaceous; very soft, becoming harder upward; very thin bedded; tan; weathers buff; calichified and leached.

33. 2.0′ Very dolomitic limestone: fossiliferous micrite to sparse biomicrite; fine to very coarse; extremely abundant randomly oriented platy shell allochems; abundant reddish-brown hematite spots; abundant miliolids; very dolomitic; medium crystalline dolomite; moderately burrowed; poorly cemented dolomitic packed biomicrite burrow fill with high leached allochem porosity; burrowing also indicated by well developed honeycomb structure; very hard; massive; buff to yellow-brown with tan burrow fill; weathers light to medium gray.

34. 1.5′ Marl: packed biomicrite; fine sand to small pebble size; apparently very argillaceous; frequent *Orbitolina* sp.; frequent oyster and other thick walled pelecypod fragments; occasional *Porocystis globularis*; apparently very intensely burrowed; grades upward into overlying bed; soft; very thin bedded; tan; weathers light tan to buff.

35. 4.0′ Limestone: packed *Orbitolina* sp. biomicrite; fine sand to small pebble size; 10% medium to very coarse platy shell allochems; occasional glauconite grains; very abundant randomly oriented *Orbitolina* sp.; occasional oyster fragments; intensely burrowed; moderately hard; massive with slight honeycomb structure; buff with tan to reddish-brown mottles.

36. 4.0′ Limestone: packed biomicrite to very muddy biosparite; fine sand to small pebble size; 20-30% coated grains in upper part; 10-15% randomly oriented platy shell allochems; occasional intraclasts; occasional glauconite grains; abundant rudists, mostly *Toucasia* sp. with some *Monopleura* sp.; abundant randomly oriented *Orbitolina* sp.; frequent miliolids and other foraminifers; abundant randomly oriented thick walled pelecypod fragments; slightly burrowed with poorly cemented burrow fill; burrowing also indicated by moderately to well developed honeycomb structure; very hard; massive; buff; weathers light gray.

37. 1.5′ Marly limestone: packed biomicrite; fine to granular; 20% randomly oriented platy shell allochems; rare to abundant *Orbitolina* sp.; very abundant granular to small pebble size oyster fragments; occasional medium to large pebble size clam steinkerns; single *Tylostoma* sp. noted; frequent high spired snails; moderately hard; thin to medium slightly nodular bedded; tan; weathers light gray.

38. 1.0′ Marl: sparse biomicrite; medium to granular; apparently very argillaceous; occasional *Orbitolina* sp.; occasional oyster fragments; soft; very thin bedded; tan with light yellow-brown mottles; weathers medium gray; calichified and leached.

39. 1.0′ Limestone: packed biomicrite to muddy biosparite; fine to very coarse; allochems in biosparite portion are subrounded to well rounded; 10% platy shell allochems oriented parallel to bedding; occasional reddish-brown hematite spots; frequent miliolids and other foraminifers; occasional *Orbitolina* sp.; biomicrite occurs as patches in biosparite, indicating burrowing; burrowing also indicated by mottling; hard; massive; tan; weathers buff.

40. 1.0′ Marl: too badly covered for adequate description; apparently very thin bedded; soft; tan to buff; weathers medium gray.

41. 2.5′ Limestone: packed biomicrite to extremely muddy *Orbitolina* sp. biosparite; fine sand to small pebble size; abundant coated grains; 20% randomly oriented platy shell allochems; abundant randomly oriented *Orbitolina* sp.; occasional thick walled pelecypod fragments; abundant *Toucasia* sp.; occasional crab fragments; slightly porous; hard; massive; buff; weathers medium gray.

42. 1.3′ Limestone: sparse biomicrite; fine to granular; 5% randomly oriented platy shell allochems; abundant oyster fragments up to small pebble size; very hard; tan; weathers dark gray.

MEASURED SECTION 4

Measured Section 4 is in the northern part of the thesis area near the east-west segment of Mount Sharp Road.

1.—— Limestone: sparse biomicrite; medium grained; moderately burrowed; packed biomicrite burrow fill; tan; weathers light brown to tan.

2. 0.2′ Limestone: slightly muddy to well washed biosparite; medium to coarse; 90% of the allochems are well rounded; 60% are coated; well sorted; 10% platy shell allochems oriented parallel to bedding or to cross beds; occasional miliolids; cross bedded and laminated; tan; weathers brownish-tan.

3. 1.0′ Limestone: packed biomicrite to very muddy biosparite; fine to granular; very abundant coated grains; 60% randomly oriented platy shell allochems; rare glauconite grains; occasional reddish-brown hematite spots; abundant miliolids and miliolid fragments; unsorted; occasional small spar-filled articulated clams; occasional small gastropods; moderately burrowed; poorly developed honeycomb structure; slightly lumpy; massive; tan to light yellow-brown; weathers reddish-brown.

4. 3.2′ Marl: calcareous mudstone to very argillaceous fossiliferous micrite; very thinly bedded; light brown with medium gray mottles; calichified.

5. 2.2′ Limestone: very intraclastic packed biomicrite; biogenic allochem grain size ranges from fine to coarse, intraclasts are medium to granular; intraclasts are subround; 60% of the biogenic allochems are platy shell fragments; 80% of the intraclasts are olive green; slightly glauconitic; abundant miliolids and miliolid fragments; very abundant pelecypod fragments; moderately fossiliferous with medium to large pebble size clam steinkerns; occasional serpulids; occasional pectins; slightly dolomitic; medium crystalline dolomite; slightly to intensely burrowed; dolomitic burrow fill; massive; lumpy; buff with tan burrow mottles; weathers medium gray.

6. 1.5′Marl: very argillaceous fossiliferous micrite to calcareous mudstone; very thinly bedded; light brown with medium gray mottles; weathers black; calichified.

7. 2.5′ Limestone: packed biomicrite to slightly muddy biosparite; medium to very coarse; allochems are rounded; 10% of the allochems are coated; very dolomitic muddy biosparite at base; dolomite content decreases upward; slightly glauconitic; abundant reddish-brown hematite spots; 10% coated mollusc fragments; intensely burrowed; massive; tan to light brown; weathers light brownish-gray.

8. 2.9′ Limestone: sparse to packed biomicrite; medium to coarse; 25% randomly oriented platy shell allochems; moderately fossiliferous with medium size clam steinkerns and occasional oyster fragments; occasional sparry vug fill; massive; light yellowish-tan; weathers medium gray.

9. 0.4′ Limestone: very muddy biosparite; medium to very coarse; laminated; massive; buff; weathers dark gray.

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10. 3.0′ Marl: fossiliferous micrite; up to 30% terrigenous mud; very thinly bedded; light brown with medium gray mottles; weathers black; calichified.

11. 0.6′ Dolomitic limestone: sparse to packed biomicrite; very fine to medium; 60% randomly oriented platy shell allochems; 60% of the allochems are pelecypod fragments; occasional reddish-brown hematite spots; 5% miliolids and other foraminifers; very dolomitic; medium crystalline dolomite; micrite matrix completely replaced by dolomite; intensely burrowed; massive; buff with tan mottles; weathers medium gray.

12. 1.6′ Marl: sparse to packed biomicrite; medium to coarse; very argillaceous; very thin bedded to massive; light yellow-brown with medium gray mottles; calichified.

13. 1.7′ Limestone: packed biomicrite; coarse grained; 5% of the allochems are intraclasts; moderately glauconitic; occasional serpulids; 10% platy pelecypod fragments; massive; tan; weathers medium gray.

14. 1.7′ Marl: calcareous mudstone to fossiliferous micrite; coarse grained; up to 30% terrigenous mud; very thinly bedded; buff; weathers buff; abundant caliche lumps.

15. 1.2′ Marl: calcareous mudstone to fossiliferous micrite; medium grained; up to 30% terrigenous mud; medium nodular bedded to lumpy; tan; weathers medium gray and reddish-brown.

16. 1.7′ Dolomitic limestone: micrite; rare allochems are very fine sand to small pebble size; occasional reddish-brown hematite spots; dolomitic; medium crystalline dolomite; original limestone texture almost completely effaced by dolomitization; appears almost lithographic; massive; buff; weathers medium gray.

17. 1.2′ Marl: fossiliferous micrite; coarse; up to 30% terrigenous mud; occasional mollusc fragments; occasional *Orbitolina* sp.; very thin bedded; light gray with light yellow-brown mottles; weathers medium gray; covered and calichified.

18. 2.3′ Dolomitic limestone: packed *Orbitolina* sp. biomicrite; medium sand to small pebble size; 60% randomly oriented platy shell allochems; extremely abundant *Orbitolina* sp.; occasional reddish-brown hematite spots; abundant thick walled pelecypod fragments; very abundant coarse sand size mollusc fragments; very dolomitic; micrite matrix completely replaced by dolomite; medium crystalline dolomite; saccharoidol; moderately to intensely burrowed; massive; buff; weathers medium gray to light brown.

19. 0.9′ Marl: sparse to packed *Orbitolina* sp. biomicrite; small pebble size; occasional rudists; tan to yellow-brown; weathers tan to light yellow-brown.

20. 3.0′ Limestone: packed *Orbitolina* sp. biomicrite to very muddy *Orbitolina* sp. biosparite; fine sand to small pebble size; 30% randomly oriented platy shell allochems; occasional reddish-brown hematite spots; extremely abundant miliolids and other foraminifers; 50% of the allochems are randomly oriented *Orbitolina* sp.; 20% medium sand size pelecypod fragments; slightly burrowed; massive with slight honeycomb structure; buff; weathers medium gray.

21. 3.1′ Marl: sparse *Orbitolina* sp. biomicrudite; granular to small pebble size; up to 30% terrigenous mud; abundant small to medium size clams; frequent oyster fragments; thin bedded; medium gray with light brown to tan mottles.

22. 2.3′ Dolomitic limestone: packed biomicrite to very muddy biosparite; 70% randomly oriented platy shell allochems; abundant light brown coarse sand size intraclasts; occasional reddish-brown hematite spots; frequent to abundant randomly oriented *Orbitolina* sp.; abundant small to medium sand size mollusc fragments; occasional small to medium pebble size clams; micrite matrix completely replaced by dolomite; moderately burrowed; buff; weathers medium gray.

23. 2.8′ Marl: sparse *Orbitolina* sp. biomicrite; granular; up to 30% terrigenous mud; occasional medium to large clam steinkerns; thinly bedded; medium gray with light brown to tan mottles.

24. 1.5′ Marly limestone: sparse *Orbitolina* sp. biomicrite; granular; abundant clam steinkerns; medium nodular bedded; buff to tan.

25. 1.5′ Marl: sparse *Orbitolina* sp. biomicrite; granular to small pebble size; up to 30% terrigenous mud; occasional mollusc fragments; occasional small to medium size clam steinkerns; rare echinoid fragments; very thin bedded; medium gray with tan to light brown mottles.

26. 1.9′ Marly limestone: sparse biomicrite; medium grained; occasional oyster fragments; occasional serpulids; frequent medium size clam steinkerns; medium nodular bedded; tan with occasional brown mottles; weathers medium gray.

27. 2.3′ Marl: sparse biomicrite; medium grained; occasional *Orbitolina* sp.; very thin bedded; buff to tan; weathers buff to tan; calichified.

28. 1.5′ Marly limestone: sparse biomicrite; medium grained; abundant reddish-brown hematite spots; frequent medium pebble size clam steinkerns; medium nodular bedded; buff to tan; weathers dark gray.

29. 0.8′ Marl: covered and calichified; weathered sample indicates fossiliferous micrite; thin bedded; tan with light brown mottles.

30. 1.8′ Dolomitic limestone: sparse biomicrite; fine to very coarse; 60% randomly oriented platy shell allochems; 25% yellow-brown allochems; abundant miliolids and miliolid fragments; occasional *Orbitolina* sp.; occasional clam impressions; very dolomitic; medium crystalline dolomite; buff; weathers medium gray.

31. 1.2′ Marl: fossiliferous micrite; coarse; up to 30% terrigenous mud; frequent *Orbitolina* sp.; frequent mollusc fragments; very thinly bedded; buff with light brown mottles; covered and calichified.

32. 1.5′ Marly limestone: sparse biomicrite; medium to granular; very fossiliferous; abundant *Porocystis globularis*; abundant medium pebble size clam steinkerns; frequent *Orbitolina* sp.; frequent oyster fragments; occasional irregular echinoids, including *Hemiaster* sp.; thin to medium nodular bedded; tan; weathers buff.

33. 1.0′ Marl: calcareous mudstone to sparse biomicrite; coarse; very thinly bedded; occasional *Porocystis globularis;* frequent *Orbitolina* sp.; occasional small clam impressions; occasional mollusc fragments; buff with light brown mottles.

34. 4.0′ Dolomitic marly limestone: packed biomicrite; fine to granular; frequent reddish-brown hematite spots; very abundant randomly oriented *Orbitolina* sp.; abundant miliolids and miliolid fragments; dolomitic; medium crystalline dolomite; original limestone texture partly effaced by dolomitization; moderately to intensely burrowed with poorly cemented burrow fill; nodular; buff to tan; weathers light gray.

35. 4.0′ Marl: sparse to packed biomicrite; medium grained; up to 30% terrigenous mud; occasional *Orbitolina* sp.; very thinly bedded; medium gray with light brown mottles; covered and calichified.

36. 1.3′ Dolomitic limestone: sparse to packed biomicrite; fine to coarse; abundant reddish-brown hematite spots; apparently slightly recrystallized; abundant miliolids; very dolomitic; dolomite replaces micrite matrix and a few allochems; original limestone texture partially effaced by dolomitization; medium crystalline dolomite; saccharoidal; slightly to moderately burrowed with extremely dolomitic burrow fill; massive; light brown to tan; weathers medium gray.

37. 2.7′ Marl: packed biomicrite; medium to granular; abundant *Orbitolina* sp.; intensely burrowed; packed biomicrite burrow fill; medium nodular bedded; light brown to tan; weathers grayish brown.

38. 1.5′ Dolomitic limestone: very muddy biosparite; fine to coarse; subrounded allochems; abundant miliolids and miliolid fragments; 5% platy mollusc fragments; very dolomitic; medium crystalline dolomite; saccharoidal; original limestone texture partially effaced by dolomitization; well developed honeycomb structure; light brown to tan; weathers medium gray.

39. 2.1′ Limestone: packed biomicrite; medium to coarse; rare *Orbitolina* sp.; moderately burrowed; burrow fill is coarse to granular; lumpy; buff to medium gray; weathers dark gray.

40. 2.2′ Marly limestone: packed biomicrite; coarse to granular; frequent *Orbitolina* sp.; slightly dolomitic; massive to very thinly bedded; buff to tan; weathers light brownish-gray.

41. 2.3′ Limestone: very muddy biosparite; coarse to granular; 30% platy mollusc fragments; moderately to intensely burrowed; brownish-gray; weathers medium gray.

42. 9.8′ Covered. No description.

43. 0.4′ Limestone: packed biomicrite; coarse; slightly laminated; lumpy; massive; tan; weathers dark gray to black.

44. 1.5′ Limestone: slightly muddy biosparite; coarse; 40% light brown allochems; frequent serpulids; 10% platy mollusc fragments; tan; weathers medium gray.

MEASURED SECTION 5

Measured Section 5 is in the northern part of the thesis area about ½ mile north of the east-west segment of Mount Sharp Road.

1. Limestone: packed biomicrite; medium to very coarse; 5% platy mollusc fragments; 10% miliolids; apparently intensely burrowed; slightly lumpy; massive; yellowish-orange; weathers light brown and medium gray.

2. 1.4′ Limestone: muddy biogenic intrasparite; medium to very coarse; 40% intraclasts; intraclasts are subrounded; occasional reddish-brown hematite spots; very abundant miliolids; medium bedded; light yellowish-gray; weathers dark gray.

3. 1.5′ Covered. No description.

4. 0.6′ Marly limestone: packed biomicrite; medium to coarse; apparently slightly recrystallized; rare *Orbitolina* sp.; moderately to intensely burrowed; very thin bedded; light yellowish-gray with yellow-brown burrow fill mottles; weathers light brownish-gray with mottles.

5. 0.8′ Dolomitic limestone: muddy intraclastic biosparite; fine to granular; abundant coated grains; allochems are well rounded; 15% of the allochems are miliolids; very dolomitic; medium crystalline dolomite; moderately burrowed with poorly cemented burrow fill; well developed honeycomb structure; buff to light grayish brown; weathers medium gray.

6. 1.7′ Limestone: slightly muddy biosparite; medium to very coarse; moderately sorted; slightly burrowed; massive; light grayish-brown; weathers light gray.

7. 0.6′ Marly limestone: packed biomicrite; moderately to intensely burrowed; burrows are apparently oriented parallel to bedding; slightly nodular bedded; light grayish-yellow; weathers light gray.

8. 1.2′ Limestone: packed biomicrite; medium to coarse; 15% randomly oriented platy mollusc fragments; 10% orangish-brown hematite stained allochems recrystallized from weathering; intensely burrowed; moderately developed honeycomb structure.

9. 2.4′ Covered. No description.

10. 0.6′ Marl: sparse biomicrite; medium to coarse; occasional *Orbitolina* sp.; light yellowish-brown; weathers light yellowish-brown; weathered and calichified.

11. 1.9′ Limestone: biogenic intrasparite; medium to granular; well rounded allochems; poorly sorted; biogenic allochems are coated; 30% randomly oriented platy shell allochems; 20% light brown stained allochems; occasional serpulids; abundant *Orbitolina* sp.; buff.

12. 0.6′ Limestone: very muddy biosparite; coarse to granular; 10% yellow-orange stained allochems; 40% randomly oriented platy mollusc fragments; light brownish-gray.

13. 0.5′ Limestone: sparse to packed biomicrudite; medium sand to large pebble size; very fossiliferous with *Trigonia* sp.; abundant large pebble size clams; abundant *Tylostoma* sp.

14. 8.7′ Mostly calichified and covered with float; two small exposures in the interval yielded the following descriptions:
    a. Lower exposure: sparse biomicrite; very coarse; up to 30% terrigenous mud; marly; soft; very thin bedded; light greenish-gray; weathers light yellowish-gray.
    b. Upper exposure: packed biomicrite; medium to coarse; 50% light brown allochems; moderately hard; massive; slightly nodular to lumpy.

15. 0.9′ Dolomitic limestone: packed biomicrite; fine to very coarse; 5% randomly oriented platy mollusc fragments; frequent miliolids and miliolid fragments; extremely dolomitic; medium crystalline dolomite; original limestone texture partially effaced by dolomitization; saccharoidal; moderately porous; very hard; buff; weathers medium gray.

16. 2.6′ Calcareous dolomite: medium crystalline; original limestone texture effaced by dolomitization; moderately porous; relict texture indicates sparse to packed biomicrite; abundant intraclasts; abundant miliolids; moderately burrowed; hard; massive; light gray; weathers medium gray.

17. 4.0′ Limestone: packed biogenic intramicrite; coarse; intensely burrowed; moderately hard; slightly nodular to lumpy; massive; light brownish-gray with reddish-brown burrow fill; weathers medium gray.

18. 1.9′ Limestone: slightly muddy biosparite; medium to very coarse; very abundant coated grains; unsorted; hard; massive; light brownish-gray; weathers medium gray.

19. 3.0′ Limestone: miliolid biomicrite; medium to very coarse; moderately burrowed; moderately hard; massive; lumpy; light brownish-gray; weathers dark gray.

20. 2.3′ Marly limestone: packed biomicrite; coarse; abundant mollusc fragments; massive; soft; light gray with reddish-brown mottles; weathers light gray; poorly exposed and covered at base; calichified.

21. 0.8′ Dolomitic limestone: very muddy intraclastic miliolid biosparite; fine to very coarse; apparently partially recrystallized; intraclasts are well rounded; extremely abundant light brown stained allochems; 30% platy shell allochems oriented parallel to bedding giving the rock a faint laminated appearance; extremely abundant miliolids; moderately to intensely burrowed; well developed honeycomb structure; light grayish-tan; weathers medium gray.

22. 0.9′ Limestone: very muddy biosparite; medium to very coarse; 10% miliolids; hard; massive; light grayish-brown; weathers medium gray.

23. 0.8′ Limestone: packed biomicrite; coarse; hard; light gray; weathers dark gray; very poorly exposed and deeply weathered.

24. 1.2′ Limestone: packed biomicrite; coarse; partially recrystallized; moderately burrowed; well developed honeycomb structure; hard; light yellowish-brown; weathers medium gray.

25. 1.0′ Limestone: packed biomicrite; medium to coarse; partially recrystallized; intensely burrowed; moderately hard; massive; lumpy; tan to brown; weathers dark gray with light tan mottles.

26. 1.8′ Limestone: slightly muddy biosparite; medium to very coarse; slightly recrystallized by weathering; occasional miliolids; slightly burrowed with muddy burrow fill; becomes moderately burrowed upward; hard; massive; buff; weathers medium gray.

27. 0.7′ Limestone: biosparite; coarse to granular; unsorted; abundant miliolids; moderately burrowed; hard; well developed honeycomb structure; tan; weathers medium gray.

28. 1.4′ Limestone: muddy biosparite; coarse; slightly recrystallized due to weathering; well sorted; 10% of the allochems are light reddish-brown stained; abundant miliolids; hard; massive; buff; weathers medium gray.

29. 2.2′ Covered slope: float and weathered in-place rock indicate limestone; sparse to packed biomicrite; coarse; moderately burrowed; light yellow-brown; weathers light tan.

30. 0.9′ Limestone: packed biomicrite; fine to very coarse; 10% light brown very coarse allochems; dolomitic; medium crystalline dolomite; massive; tan to light brown; weathers medium gray.

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31. 5.0′ Dolomite: fine to medium crystalline; 5% leached allochem porosity; abundant light reddish-brown hematite spots; weathers blocky; massive; light grayish-brown; weathers buff with black mottles; mostly covered.

32. 2.0′ Limestone: muddy biosparite; coarse to granular; 70% platy mollusc fragments oriented parallel to bedding; hard; buff; weathers medium gray.

33. ——— Marly limestone: very muddy biosparite; 90% of the allochems are light brown to light reddish-brown stained; frequent miliolids; massive; reddish-brown; weathers very dark brown.

MEASURED SECTION 6

Measured Section 6 is on one of the cut banks of the Blanco River about 1½ miles southwest of Wimberley.

1. —— Limestone: miliolid biosparite; fine to very coarse; moderately sorted; 2-3% randomly oriented platy shell allochems; 60% of the allochems are miliolids; moderately burrowed with very dolomitic packed miliolid biomicrite burrow fill; medium crystalline dolomite; massive; poorly developed honeycomb structure; hard; buff with tan burrow fill mottles; weathers medium gray.

TOP OF MEMBER D

2. 0.9′ Dolomitic limestone: miliolid bearing packed biomicrite; fine to coarse; 10% of the allochems are miliolids; 5% yellowish to reddish-brown stained allochems; abundant plant fragments; extremely dolomitic; medium crystalline dolomite, extent of dolomitization varies across bands parallel to bedding; very low (1-2%) porosity; moderately soft; nodular bedded; buff; weathers tan to medium gray.

3. 0.7′ Dolomite: medium to coarsely crystalline; saccharoidal; variable porosity ranging from 5-20%; relict texture indicates sparse to packed biomicrite; medium to very coarse; relict burrowing indicated by patchy development of leached allochem porosity; moderately soft; massive; weathers blocky; mottled medium gray and tan; weathers dark gray to black.

4. 1.9′ Dolomite: medium to coarsely crystalline; saccharoidal; very low (1-2%) porosity; very faint relict texture indicates sparse biomicrite; moderately soft; massive; weathers blocky; weathers dark gray to black.

5. 0.9′ Dolomite: medium crystalline; low (1-2%) leached allochem porosity; massive; nearly textureless; moderately soft; weathers recessive and blocky; tan with light yellow-brown mottles; weathers dark gray to black.

6. 1.4′ Dolomitic limestone: miliolid bearing biomicrite; medium to coarse; moderately sorted; 5% of the allochems are miliolids; 15% of the allochems are well rounded medium to coarse grained dark brown intraclasts; 25% light yellow-brown stained allochems; slightly dolomitic; medium crystalline floating dolomite rhombs; massive; moderately hard; tan; weathers medium gray.

7. 0.9′ Dolomite: medium crystalline; up to 20% leached allochem porosity; saccharoidal; relict texture indicates packed biomicrite; medium to very coarse; massive; moderately soft; weathers blocky; tan with light yellow-brown mottles; weathers dark gray to black.

8. 1.9′ Dolomite: medium crystalline; moderate (8-10%) leached allochem porosity; saccharoidal; relict texture indicates packed biomicrite; fine to very coarse; very slightly mottled gray and tan; moderate relict burrowing; massive; weathers blocky; moderately soft; weathers tan to dark gray.

9. 2.3′ Dolomite: medium crystalline; high (15-20%) leached allochem porosity; relict texture indicates packed biomicrite; medium to very coarse; irregular development of porosity corresponds to mottled medium gray and tan color; abundant ½″-1″ vugs throughout indicate possible leached evaporites; massive; weathers blocky; moderately soft; very soft and apparently argillaceous at base; weathers tan to dark gray.

10. 0.3′ Very dolomitic limestone: packed biomicrite; medium to very coarse; platy shell allochems oriented parallel to bedding impart faint laminated appearance; very dolomitic; medium crystalline dolomite; saccharoidal; low (1-2%) porosity; slightly mottled; mudcracks at top; massive.

11. 1.4′ Dolomitic limestone: packed biomicrite; fine to coarse; 5% randomly oriented platy shell allochems; 15% light yellow-brown stained allochems; frequent miliolids; rare crab and oyster fragments; moderately dolomitic; medium crystalline dolomite; moderately hard; thin nodular bedded; buff; weathers medium gray.

12. 0.8′ Dolomite: medium crystalline; low (4-5%) porosity; relict texture indicates sparse to packed biomicrite; frequent miliolids; medium to very coarse; moderately hard; massive; weathers blocky; buff; weathers dark gray.

13. 2.2′ Dolomite: fine to medium crystalline; saccharoidal; low (3-5%) porosity; abundant reddish-brown stained spots; relict texture too faint for interpretation; massive; weathers blocky; moderately soft; mottled medium gray and tan.

14. 5.8′ Dolomitic marly limestone: packed biomicrite; fine to very coarse; 40% yellowish to reddish brown stained allochems; rare *Porocystis globularis*; occasional whole and fragmented oyster shells; extremely dolomitic; 10-20% dolomite occurring as medium crystalline floating rhombs; saccharoidal; low (2-5%) porosity; apparently very argillaceous; moderately hard; massive; weathers recessive to blocky; buff to medium gray; weathers tan.

15. 1.1′ Dolomite: fine to coarse crystalline; relict texture indicates sparse to packed biomicrite; medium to very coarse; 70% randomly oriented platy shell allochems; moderate to high (5-15%) porosity; contains two laminated finely crystalline dolomite beds in upper half that are probably supratidal crusts; upper half has very coarse to granular leached allochem holes.

16. 3.5.′ Dolomite: medium to coarsely crystalline; saccharoidal; moderate to high (10-15%) leached allochem porosity; very faint relict texture indicates sparse to packed biomicrite; fine to coarse; lower 1/3 has irregular development of porosity indicating relict moderate to intense burrowing; massive; moderately soft; weathers blocky; tan with light yellow-brown mottles; weathers dark gray to black.

17. 1.9′ Dolomite: medium crystalline; high (20-25%) porosity; saccharoidal; relict texture indicates packed biomicrite; fine to coarse; slightly burrowed; burrow fill is more porous than the unburrowed portion; slightly mottled; massive; weathers blocky; moderately soft; buff to tan; weathers buff to dark gray.

18. 1.5′ Dolomitic limestone: packed biomicrite; medium to granular; frequent miliolids; frequent platy pelecypod fragments oriented parallel to bedding; 1-2% reddish-brown stained allochems; moderately dolomitic; dolomite replaces micrite leaving calcareous allochems; medium to coarsely crystalline dolomite; very faintly laminated; moderately hard; slightly nodular to flaggy; buff; weathers medium gray.

19. 1.0′ Limestone: biogenic intramicrite; fine to coarse; 20% platy shell allochems oriented parallel to bedding; cross bedded; 30% of the allochems are intraclasts; 5% are miliolids; occasional patches of dolomitic biomicrite; moderately burrowed; hard; massive; slightly mottled; buff; weathers medium gray.

20. 1.1′ Dolomite: medium crystalline; saccharoidal; high (20%) leached allochem porosity; 30% of the leached allochem pores are light yellow-brown stained; relict texture indicates packed biomicrite; medium to very coarse; 10% randomly oriented platy shell allochems; moderately soft; mottled tan and light yellow-brown.

21. 1.2′ Marly limestone: packed biomicrite; fine to very coarse; 2-3% randomly oriented platy shell allochems; 20% light yellow-brown stained allochems; intensely burrowed; nodular to recessive; tan with buff burrow fill; weathers tan to medium gray; badly covered.

22. —— Limestone: sparse to packed biomicrite; very fine to coarse; 1% randomly oriented platy shell allochems; 20% light yellow-brown stained allochems; occasional whole miliolids and abundant miliolid fragments; hard; massive; buff; mottled medium gray and tan to light yellow-brown; weathers medium gray.

MEASURED SECTION 7a

Measured Section 7a is a short distance east of the eastern margin of the thesis area about 1 mile southeast of Wimberley. Measured Sections 7a and 7b are two parts of a continuous section that are connected by a traverse. They are presented here separately because the lower part is situated just outside the eastern boundary of the thesis area.

1. ——— Limestone: slightly intraclastic; slightly muddy; miliolid bearing biosparite; medium to granular; unsorted; 20% light brown allochems; 5-10% miliolids; hard; massive; tan.

2. 0.6′ Very dolomitic limestone: miliolid bearing extremely muddy biosparite; very fine to very coarse; occasional coated grains; unsorted; 5% randomly oriented mollusc allochems; occasional medium to very coarse intraclasts; 10% miliolids; micrite matrix completely replaced by dolomite; medium crystalline dolomite; highly porous with intergranular porosity; slightly to moderately burrowed with extremely dolomitic burrow fill; massive; tan with light gray mottles.

3. 1.5′ Dolomitic limestone: extremely muddy biosparite; medium to granular; occasional coated grains; 5% medium to very coarse intraclasts; intraclasts are yellow-brown to olive green; 5% light brown allochems; rare to frequent miliolids; micrite matrix completely replaced by dolomite; medium crystalline dolomite; highly porous with leached allochem porosity; saccharoidal; moderately burrowed at base; hard; buff to light grayish-brown; weathers dark gray.

4. 1.5′ Marl: calcareous mudstone to packed biomicrite; medium to very coarse; allochems are brown; up to 30% terrigenous mud; occasional small clams; occasional serpulid fragments; intensely burrowed; moderately hard; massive; medium gray to dark gray with light gray mottles.

5. 1.5′ Marl: packed biomicrite; medium to coarse; light brown allochems; up to 30% terrigenous mud; occasional small clams; moderately to intensely burrowed; soft; slightly nodular bedded to massive; light brown with medium gray mottles.

6. 1.2′ Dolomitic limestone: very muddy biogenic intrasparite; medium to granular; frequent coated grains; intraclasts are yellow-brown to olive; many intraclasts are coated; slightly glauconitic; frequent miliolids; micrite matrix completely replaced by dolomite; medium crystalline dolomite; slightly to intensely burrowed with dolomitic burrow fill; hard; massive; light greenish-gray; weathers dark gray.

7. 2.0′ Marl: packed biomicrite; medium grained; up to 30% terrigenous mud; moderately soft; slightly nodular bedded; massive; light greenish-gray; weathers buff.

8. 1.1′ Dolomitic limestone: packed biomicrite to very muddy biosparite; fine to very coarse; frequent coated grains; high leached allochem porosity of medium sand to small pebble size; occasional oyster fragments; rare serpulids; rare randomly oriented platy mollusc fragments; hard; massive; light tan; weathers medium gray.

9. 0.7′ Limestone: packed biomicrite; medium to coarse; 5% randomly oriented platy mollusc fragments; occasional miliolids; slightly dolomitic; moderately soft; massive; light tan; weathers medium gray.

10. 3.8′ Dolomitic limestone: packed biomicrite to very muddy biosparite; fine to very coarse; frequent possible glauconite grains; extremely abundant miliolids; micrite matrix completely replaced by dolomite; highly porous with leached allochem porosity; medium crystalline dolomite; saccharoidal; hard; buff with medium gray mottles.

11. 0.9′ Limestone: extremely muddy biosparite; medium to coarse; rare miliolids; moderately burrowed; lumpy; massive; light orangish-brown.

12. 1.3′ Marl: packed biomicrite; medium to coarse; 1% light yellow-brown allochems; 20% terrigenous mud; slightly dolomitic; soft; very thinly bedded; light tan.

13. 4.0′ Dolomitic marl: packed biomicrite to extremely muddy biosparite; fine to very coarse; abundant coated grains; subrounded; occasional miliolids; dolomitic; medium crystalline dolomite; very porous with leached allochems and intergranular porosity; intensely burrowed; hard; massive; light grayish-tan to buff.

14. 2.0′ Marl: packed biomicrite; medium to very coarse; frequent medium pebble size mollusc fragments; subrounded; slightly dolomitic; moderately hard; very thin bedded to massive; light tan; weathers light yellow-brown.

15. 4.4′ Very dolomitic limestone: packed miliolid biomicrite to extremely muddy miliolid biosparite; fine to very coarse; occasional to abundant randomly oriented platy shall allochems; abundant intraclasts; abundant reddish-brown hematite spots near top; frequent to very abundant miliolids; rare serpulids; moderately to very dolomitic; medium crystalline dolomite; saccharoidal; very porous with leached allochem porosity; original limestone texture slightly effaced by dolomitization near the top; moderately burrowed at the top; very hard; massive; tan with buff mottles; weathers dark gray.

16. 1.1′ Dolomitic marl: packed biomicrite; medium to very coarse; reddish-brown allochems; moderately dolomitic; medium crystalline dolomite; moderately soft; thin nodular bedded; buff; weathers dark gray.

17. 1.3′ Dolomitic limestone: extremely muddy miliolid biosparite; medium to very coarse; rounded allochems; 5% of the allochems are coated; occasional to extremely abundant miliolids; occasional crab fragments; moderately burrowed; slight to moderate leached allochem and intergranular porosity; moderately dolomitic with extremely dolomitic burrow fill; burrow fill is saccharoidal; hard; buff; weathers medium gray.

18. 1.7′ Dolomitic limestone: muddy miliolid biosparite; medium to coarse; rounded allochems; sorted; abundant platy shell allochems oriented parallel to bedding; extremely abundant miliolids and other foraminifers; moderately porous with intergranular porosity; micrite matrix completely replaced by dolomite; saccharoidal; very hard; massive; buff; weathers medium gray.

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19. 2.3′ Extremely dolomitic limestone: packed miliolid biomicrite; medium to coarse; 5% platy shell allochems oriented parallel to bedding; abundant reddish-brown hematite spots; extremely dolomitic; micrite matrix completely replaced by dolomite; saccharoidal; occasional patches of textureless dolomite; fine crystalline dolomite; dense; buff to light brownish-tan with reddish-brown mottles.

20. 1.2′ Dolomitic marl: original limestone texture effaced by dolomitization; coarse grained ghost allochems; abundant reddish-brown hematite spots; very soft; massive; thin bedded; light brownish-tan.

21. 5.9′ Dolomite: medium crystalline; saccharoidal; relict texture indicates sparse to packed biomicrite; abundant reddish-brown hematite spots; abundant ghost burrowing; moderate leached allochem porosity; 10-15% leached allochem porosity in burrow fill; swirled structure; massive; weathers blocky; tan with light yellow-brown mottles; weathers black.

22. 0.7′ Dolomitic limestone: packed biogenic intramicrite; fine to granular; intraclasts are up to small pebble size and are elongate parallel to bedding; 10% platy shell mollusc fragments oriented parallel to bedding; abundant miliolids and miliolid fragments; moderately dolomitic; medium crystalline dolomite; original limestone texture partially effaced by dolomitization; slightly porous with leached allochem porosity; micrite matrix completely replaced by dolomite; laminated; massive; buff; weathers medium gray.

23. 9.9′ Dolomitic marl: packed biomicrite; coarse to granular; 60% light brown allochems; abundant *Porocystis globularis*; up to 30% dolomite; medium crystalline dolomite; soft; thin nodular bedded; buff; weathers medium gray.

24. 0.9′ Dolomitic limestone: packed biogenic intramicrite; fine to very coarse; intraclasts are well rounded and yellow-brown to green; 20% light

reddish-brown allochems; abundant randomly oriented platy shell allochems; abundant miliolids; moderately dolomitic; medium crystalline dolomite; saccharoidal; original limestone texture partially effaced by dolomitization; single large vug noted; hard; massive; buff to light orangish-brown; weathers medium gray.

25. 1.3′ Dolomitic limestone: packed miliolid biomicrite; medium to very coarse; 10% olive green to light brown glauconitic grains; abundant miliolids; moderately dolomitic; medium crystalline dolomite; moderately burrowed; extremely dolomitic burrow fill; hard.

26. 2.0′ Dolomitic marl: sparse biomicrite; coarse; moderately dolomitic; medium crystalline dolomite; intensely burrowed; soft; massive; light brown with tan mottles; weathers dark gray.

27. 0.4′ Very dolomitic limestone: sparse to packed biomicrite; medium to coarse; 3-5% randomly oriented platy shell allochems; frequent miliolids; very dolomitic; medium crystalline dolomite; saccharoidal; original limestone texture partially effaced by dolomitization; moderately hard; massive; buff; weathers dark gray.

28. 2.2′ Marl: sparse biomicrite; medium to coarse; moderately burrowed; soft; massive; grayish-tan with light yellow-brown mottles; weathers dark gray.

29. 1.3′ Dolomitic limestone: muddy intrasparite to slightly muddy biosparite; fine to granular; well rounded intraclasts; slightly glauconitic; abundant miliolids and other foraminifers; moderately dolomitic; saccharoidal; slightly porous with intergranular porosity; very hard; massive; tan; weathers medium gray.

30. 4.5′ Covered. Single small exposure in the middle of the interval yielded the following description — Dolomite: fine crystalline; dense; soft; light grayish-brown with light reddish-brown mottles; weathers buff with black mottles.

31. 1.1′ Limestone: packed biomicrite; medium to coarse; abundant serpulids; slightly dolomitic; slightly laminated; hard; light yellow; weathers medium gray.

32. 1.0′ Slightly dolomitic limestone: muddy intraclastic biosparite; coarse to granular; allochems are well rounded; 15% intraclasts; 40% light brown stained allochems; 5% platy shell allochems oriented parallel to bedding; abundant miliolids and other foraminifers; slightly dolomitic; medium crystalline dolomite; dolomite replaces both calcareous allochems and spar fill; high intergranular and leached allochem porosity; hard; light gray with buff mottles; weathers medium gray.

33. 1.0′ Dolomitic limestone: packed miliolid biomicrite to extremely muddy biosparite; medium to coarse; 5% light yellow-brown intraclasts; extremely abundant miliolids; very dolomitic; medium crystalline dolomite; saccharoidal; high leached allochem porosity; moderately burrowed with extremely dolomitic poorly cemented burrow fill; hard; massive; tan to light brown with tan mottles; weathers medium gray.

34. 0.7′ Dolomitic limestone: muddy miliolid biosparite; medium to granular; moderately rounded allochems; occasional to extremely abundant miliolids; very dolomitic; medium crystalline dolomite; dolomite replaces spar cement; saccharoidal; low leached allochem porosity; slightly burrowed; hard; massive; buff to light tan with light yellow burrow mottles; weathers light gray.

35. 1.5′ Limestone: packed biomicrite to slightly muddy biosparite; fine to very coarse; biosparite occurs as patches within biomicrite; well rounded allochems; extremely abundant miliolids; slightly dolomitic in places; medium crystalline dolomite; slightly burrowed with muddy burrow fill; hard; massive; tan with buff mottles; weathers medium gray.

36. 3.2′ Limestone: very muddy biosparite; medium to very coarse; 10% yellow-brown allochems; 1-2% coarse mollusc fragments; abundant small clam shells and impressions; occasional miliolids; slightly dolomitic; massive; buff; weathers medium gray.

37. 1.0′ Dolomitic limestone: packed biomicrite to very muddy biosparite; fine to very coarse; occasional reddish-brown hematite spots; frequent to abundant miliolids; 15% mollusc fragments; very abundant *Monopleura* sp., most of which are filled with spar and micrite, usually with a mud core surrounded by a spar rim, all enclosed in a recrystallized *Monopleura* sp. shell; very hard; massive; extremely dolomitic with medium crystalline dolomite; saccharoidal; buff; weathers medium gray.

38. 2.3′ Dolomitic limestone: packed miliolid biomicrite; fine to very coarse; occasional subrounded intraclasts; occasional platy shell allochems oriented parallel to bedding; abundant to extremely abundant miliolids; slightly dolomitic; medium crystalline dolomite; saccharoidal; micrite almost completely replaced by dolomite; occasional patches of textureless dolomite; rare granular reddish-brown vugs; hard; massive; weathers medium gray.

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39. 4.0′ Marly limestone: packed biomicrite; medium to coarse; occasional miliolids; rare fossils include small snails; slightly dolomitic; medium crystalline dolomite; apparently intensely burrowed; moderately hard; medium nodular bedded to massive; tan; weathers buff to light gray.

40. 0.7′ Dolomitic limestone: sparse to packed miliolid biomicrite; fine to coarse; slightly recrystallized; abundant to extremely abundant miliolids and miliolid fragments; micrite matrix almost completely replaced by dolomite; medium crystalline dolomite; saccharoidal; original limestone texture partially effaced by dolomitization; moderately burrowed; poorly developed honeycomb structure; hard; buff with tan mottles.

41. 1.2′ Limestone: sparse biomicrite; medium to coarse; 1-2% randomly oriented platy mollusc fragments; abundant miliolids; slightly dolomitic; medium crystalline dolomite; hard; massive; light gray; weathers medium gray.

42. 4.2′ Marl and limestone: covered marl overlain by more resistant limestone. Limestone is a sparse biomicrite; medium to coarse; occasional miliolids; slightly recrystallized; moderately burrowed; hard; moderately well developed honeycomb structure; buff; weathers medium gray.

MEASURED SECTION 7b

Measured Section 7b is near the eastern margin of the thesis area about 1.2 miles southeast of Wimberley.

43. 2.0′ Marl: sparse to packed biomicrite; fine to coarse; up to 30% terrigenous mud; sparse small clams and snails; very soft; very thin bedded to massive; light gray with light brown mottles.

44. 4.3′ Marl: packed biomicrite; fine to very coarse; 5% coarse to very coarse light yellow-brown allochems; sparsely fossiliferous with occasional serpulids, *Trigonia* sp., oysters, occasional small to large clams; 10% medium to coarse platy mollusc fragments; slightly dolomitic; intensely burrowed; moderately hard; medium nodular bedded; tan; weathers buff with medium gray mottles.

45. 2.5′ Marl: fossiliferous micrite to sparse biomicrite; medium to granular; up to 30% terrigenous mud; frequent granular to small pebble size mollusc fragments; rare high spired snails; very soft; very thin bedded to massive; medium gray with yellow-brown mottles; weathers medium gray with yellow-brown mottles.

46. 0.8′ Limestone: very muddy biosparite; medium to very coarse; abundant granular mollusc allochems; abundant miliolids; occasional small clams and pelecypods; moderately to intensely burrowed; hard; massive; tan; weathers medium gray.

47. 3.2′ Marl: packed biomicrite; medium to very coarse; abundant miliolids; occasional coarse randomly oriented platy mollusc fragments; intensely burrowed; moderately hard; buff; weathers medium gray.

48. 2.0′ Marly limestone: packed biomicrite; fine to very coarse; rare miliolids; 5% coarse sand to small pebble size randomly oriented platy mollusc fragments; intensely burrowed; moderately hard; massive; buff; weathers medium gray.

49. 2.0′ Marl: packed biomicrite; medium to very coarse; 2% dark reddish-brown allochems; intensely burrowed; moderately hard; thin to medium nodular bedded to massive; buff with brown mottles; weathers medium gray.

50. 1.5′ Dolomitic limestone: packed intraclastic biomicrite to extremely muddy biosparite; fine to granular; very abundant randomly oriented platy shell allochems; 15% yellow-brown intraclasts; abundant reddish-brown hematite spots; frequent mollusc fragments recrystallized to sparry calcite; rare to abundant miliolids and other foraminifers; very dolomitic; micrite matrix completely replaced by dolomite; medium crystalline; saccharoidal; original limestone texture partially effaced by dolomitization; moderately burrowed; abundant spar filled vugs; hard; moderately well developed honeycomb structure; buff to tan with light reddish-brown mottles.

51. 1.0′ Limestone: muddy biosparite; medium sand to small pebble size; abundant coated grains; allochems are subrounded to well rounded; 80% of the allochems are light reddish-brown; occasional randomly oriented platy shell allochems; 40% granular to small pebble size mollusc fragments; abundant spar filled gastropods; very hard; massive; buff to light reddish-brown; weathers dark gray.

52. 2.5′ Marl: fossiliferous micrite to sparse biomicrite; coarse to very coarse; up to 30% terrigenous mud; very soft; very thin bedded to massive; grayish brown; weathers buff; covered.

53. 0.8′ Descriptions from two units as follows:
    a. Lower unit: Limestone; sparse biomicrite; fine to medium; frequent miliolids; moderately soft; massive; buff; weathers medium gray.
    b. Upper unit: Limestone; slightly muddy intraclastic biosparite; medium to coarse; allochems are rounded to well rounded; well sorted; extremely abundant intraclasts; intraclasts are light reddish-brown to yellow-brown; 10% dark reddish-brown allochems; abundant to extremely abundant miliolids and other foraminifers; thin laminae of medium crystalline dolomite near base; very hard; low angle cross bedded; massive; buff to tan; weathers medium gray.

54. 4.0′ Marl: sparse biomicrite; fine to medium; apparently contains terrigenous mud; slightly fossiliferous; frequent small clam impressions; single bone fragment noted; occasional crab fragments; occasional *Trigonia* sp. impressions; occasional *Nerinea* sp. and other high spired gastropods; abundant crab claws at top; moderately soft; thin nodular bedded; grayish tan; weathers grayish tan with light reddish-brown mottles.

55. 0.9′ Marly limestone: sparse biomicrite; fine to coarse; brown allochems; moderately burrowed; moderately hard; well developed honeycomb structure; light brown to buff; weathers medium gray.

56. 4.0′ Marly limestone: packed biomicrite; medium to very coarse; 15% light yellow-brown allochems; up to 20% terrigenous mud; slightly dolomitic; medium crystalline dolomite; moderately to intensely burrowed; moderately hard; massive; buff with tan mottles; weathers buff to light gray.

57. 1.2′ Dolomitic limestone: sparse to packed biomicrite; fine to very coarse; abundant reddish-brown intraclasts; occasional to abundant miliolids; extremely dolomitic; medium crystalline dolomite; saccharoidal; micrite matrix completely replaced by dolomite; original limestone texture partially effaced by dolomitization; hard; buff; weathers buff to light gray.

58. 2.6′ Marly limestone: packed biomicrite; medium to granular; slightly glauconitic; occasional to frequent crab fragments; frequent oyster fragments; slightly

66. 6.5′ Dolomitic marl: packed biomicrite; medium to coarse; up to 30% terrigenous mud; occasional *Nerinea* sp.; abundant oysters; occasional *Loriola* sp.; moderately dolomitic; medium crystalline dolomite; moderately soft; reddish-brown with buff mottles; weathers dark reddish-brown.

67. 5.7′ Dolomitic marly limestone: fossiliferous micrite to sparse biomicrite; medium to coarse; occasional miliolids; very dolomitic; up to 30% dolomite; medium crystalline dolomite; intensely burrowed; moderately hard; massive; buff with tan mottles.

68. 0.8′ Limestone: packed biomicrite; medium to coarse; 5% light yellow-brown allochems; slightly dolomitic; medium crystalline dolomite; intensely burrowed; hard; massive; buff with tan mottles.

69. 7.7′ Dolomitic limestone: packed biomicrite; fine to coarse; frequent miliolids, decreasing in number upward; frequent randomly oriented coarse sand size platy shell allochems; slightly dolomitic; medium crystalline dolomite; massive; buff; weathers medium gray.

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70. 2.3′ Extremely dolomitic limestone: packed biomicrite; fine to coarse; occasional miliolids at base, increasing in number upward to very abundant; 5% yellow brown allochems; extremely dolomitic; medium crystalline dolomite; saccharoidal; massive; buff; weathers medium gray; takes on porous structureless dolomite appearance when weathered.

71. 2.5′ Marly limestone: packed biomicrite; medium to coarse; poorly sorted; 10% iron stained allochems; 5% platy pelecypod fragments; thin nodular bedded; light brown to tan.

72. 1.2′ Dolomitic limestone: packed biomicrite to muddy biosparite; fine to coarse; well sorted; well rounded; 5% light brown allochems; frequent yellow-brown intraclasts; occasional to abundant miliolids; 5% platy pelecypod fragments; very dolomitic; medium crystalline dolomite; saccharoidal; original limestone texture partially effaced by dolomitization; massive; tan.

73. 2.2′ Marly limestone: packed biomicrite; medium to very coarse; moderately sorted; 5% of the allochems are iron stained; 10% randomly oriented pelecypod fragments; occasional oyster fragments; up to 20% dolomite; moderately to intensely burrowed; thin nodular bedded.

74. 2.0′ Dolomite: medium crystalline; 10% leached allochem porosity 5% of the pores are hematite filled; rare ghost allochems; thin to medium bedded with very thinly bedded dolomitic biomicrite at base; buff to tan.

75. 0.8′ Very dolomitic marly limestone: packed biomicrite; medium to very coarse; moderately sorted; occasional miliolids mostly in burrow fill; very dolomitic; medium crystalline dolomite; massive; intensely burrowed; light tan with buff to light brown burrow mottles.

76. 1.2′ Very dolomitic marly limestone: sparse biomicrite; contains occasional patches of probable burrow fill with very abundant miliolids; very dolomitic; up to 50% dolomite; medium cystalline dolomite; intensely burrowed; massive; light gray with dark gray burrow mottles.

77. 2.5′ Very dolomitic limestone: packed biomicrite; medium to very coarse; 10% iron stained allochems; very dolomitic; medium crystalline dolomite; thin to medium nodular bedded; light gray with dark gray mottles.

78. 1.3′ Very dolomitic limestone: packed biomicrite; medium sand to small pebble size; poorly sorted; abundant iron stained allochems; 10% randomly oriented pelecypod fragments; abundant miliolids in burrow fill; very dolomitic; up to 30% dolomite in burrow fill; moderately to intensely burrowed; thin nodular bedded; buff to reddish-brown.

79. 3.0′ Dolomitic marl: packed biogenic intramicrite; coarse to granular; poorly sorted; 40% of the allochems are very coarse intraclasts; 10% randomly oriented platy pelecypod fragments; moderately dolomitic; very dolomitic in muddy burrow fill; moderately burrowed; thin nodular bedded; light tan to white with buff burrow mottles.

80. 2.7′ Dolomite: medium crystalline; 15% leached allochem porosity; occasional ghost allochems; 60% of the ghost allochems are hematite filled; massive to medium bedded; weathers blocky; light brown to buff.

81. 4.3′ Extremely dolomitic limestone: packed biomicrite; medium to very coarse; poorly sorted; abundant yellow-brown intraclasts; abundant miliolids and other foraminifers; extremely dolomitic; medium crystalline dolomite; saccharoidal; original limestone texture partially effaced by dolomitization; high intergranular and leached allochem porosity; intensely burrowed; irregularly laminated at base; massive; tan.

82. 5.0′ Dolomite: medium crystalline; 15% leached allochem porosity; 85% of the leached allochems are hematite filled; medium bedded to massive; grayish-brown.

83. 8.0′ Extremely dolomitic marl: packed biomicrite; medium to coarse; original limestone texture partially effaced by dolomitization; 50% of the allochems are limonite or hematite stained; extremely dolomitic; up to 50% dolomite; medium crystalline dolomite; moderately to intensely burrowed; very light tan.

84. 5.0′ Dolomite: medium to coarsely crystalline; 20% leached allochem porosity with most pores containing limonite or hematite; occasional miliolids and miliolid fragments.

85. 10.0′ Extremely dolomitic marl: packed biomicrite; medium to granular; poorly sorted; abundant hematite stained allochems; abundant medium pebble size oyster fragments; extremely dolomitic; up to 50% dolomite; moderately to intensely burrowed; thin to medium nodular bedded.

86. 3.5′ Covered. Probably the same as bed 85.

87. 2.2′ Dolomite: medium crystalline; saccharoidal; high leached allochem porosity; relict texture indicates packed biomicrite; medium to coarse; 40% of the leached allochem pores are hematite stained; medium bedded; weathers blocky; buff to tan.

88. 1.6′ Extremely dolomitic limestone: original limestone partially effaced by dolomitization; faint relict texture indicates packed biomicrite; medium to very coarse; occasional yellow-brown intraclasts; occasional miliolids; 3% of the allochems are platy pelecypod fragments oriented parallel to bedding; medium crystalline dolomite; saccharoidal; moderate intergranular and leached allochem porosity; 5-10% of the allochems are iron stained; thin to medium flaggy bedded; light tan.

89. 0.8′ Dolomitic limestone: packed biomicrite to well washed biosparite; fine sand to small pebble size; moderately sorted; occasional sand size allochems are well rounded; abundant platy shell allochems oriented parallel to bedding, giving the rock a faint laminated appearance; very abundant miliolids; very dolomitic; medium crystalline dolomite; extent of dolomitization is patchy and effaces original limestone texture in some places; low leached allochem porosity; buff.

90. 1.8′ Extremely dolomitic limestone: packed biomicrite; medium to coarse; 15% of the allochems are hematite stained; most allochems are ghost; very dolomitic; up to 50% dolomite; massive; light tan to buff.

91. 0.7′ Extremely dolomitic marl: packed biomicrite; coarse to granular; poorly sorted; extremely dolomitic; moderately to intensely burrowed; thin nodular bedded; light brown to tan.

92. 0.7′ Dolomite: medium crystalline; 5% moldic porosity; massive to medium bedded; light grayish brown.

93. 1.2′ Marl: fossiliferous micrite; occasional hematite spots, possibly associated with plant fragments; burrowed; thin nodular bedded; weathers with lumpy surface; buff to tan with brown patches.

94. 1.5′ Dolomite: medium crystalline; low porosity; grades into overlying bed; massive, tan to brown.

95. 1.1′ Dolomite: medium crystalline; 15% leached allochem porosity; moderately burrowed; lumpy weathering surface; light brown with gray mottles.

96. 1.9′ Dolomitic limestone: packed miliolid biomicrite to muddy biosparite; medium to granular; moderately sorted; frequent to abundant intraclasts; 20% pelecypod fragments oriented parallel to bedding; extremely abundant miliolids; extremely dolomitic; medium crystalline dolomite; original limestone texture partially effaced by dolomitization; moderately burrowed; massive; buff to tan.

97. 2.5′ Dolomite: medium crystalline; 5% leached allochem porosity, increasing upward to 20%; occasional ghost burrowing; massive; weathers blocky; weathers medium gray to tan.

98. 0.3′ Limestone: biosparite; coarse to granular; moderately sorted; 80% of the allochems are platy pelecypod fragments oriented parallel to bedding; laminated.

99. 5.0′ Marl: packed biomicrite; medium to very coarse; poorly sorted; 25% of the allochems are iron stained; abundant *Nerinea* sp.; abundant *Turitella* sp.; abundant small clams; abundant *Exogyra* sp.; up to 40% dolomite; moderately to intensely burrowed; massive; lumpy weathering surface.

100. 3.3′ Dolomitic marl: fossiliferous micrite; very argillaceous; very dolomitic; occasional spots and patches of iron stain; some small iron stain spots may be associated with plant fragments; massive.

101. 3.4′ Dolomite; medium crystalline; 5% leached allochem porosity; up to 30% porosity in middle; medium to thick bedded; light grayish-tan.

102. 3.0′ Dolomite: medium crystalline; 15% leached allochem porosity; occasional ghost allochems; moderately burrowed; lumpy weathering surface; buff; mottled.

103. 0.9′ Dolomitic marl: packed biomicrite; medium to very coarse; moderately sorted; very dolomitic; up to 50% dolomite; intensely burrowed; thin nodular bedded; light reddish-brown; weathers buff.

104. 10.0′ Dolomite: medium crystalline; 5-10% leached allochem porosity; up to 20% porosity in middle; moderately burrowed at base; massive through the rest; buff with tan mottles.

105. 3.0′ Dolomite: medium crystalline; less than 5% porosity; abundant undolomitized allochems; moderately burrowed; very porous burrow fill; contains abundant gypsum; slightly nodular in some parts; weathers white at top.

106. 5.0′ Dolomite: medium crystalline; porosity ranges from 0-10%; occasional ghost miliolids and platy pelecypod fragments oriented parallel to bedding; massive; light brown; white calichified weathering surface.

107. 0.6′ Dolomite: medium to finely crystalline; abundant ghost allochems indicate relict laminated structure; thin to medium bedded; light brown to tan; weathers white.

108. 1.1′ Dolomite: medium crystalline; moderately to extensively burrowed; variable porosity, with burrow fill most porous; lumpy to nodular on weathered surface; abundant secondary calcite in veinlets or vugs.

109. 11.5′ Dolomite: medium crystalline; low leached allochem porosity; original limestone texture completely effaced by dolomitization; tan to yellowish-brown with reddish-brown iron stained mottles; mostly covered and calichified.

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110. 1.8′ Limestone: biosparite; medium to very coarse; moderately sorted; frequent platy pelecypod fragments oriented parallel to bedding, giving the bed a faint laminated appearance; occasional oysters, probably *Exogyra* sp.; possibly dolomitic; 15-20% porosity; moderately to extensively burrowed; dark grayish brown.

111. 0.8′ Limestone: biosparite; medium to very coarse; partially recrystallized; abundant *Nerinea* sp.; moderately burrowed; massive; light gray.

112. 3.2′ Covered and calichified. No description.

113. 1.3′ Dolomitic limestone: packed biomicrite to muddy biosparite; fine to very coarse; moderately sorted; subrounded to well rounded; 10% iron stained biogenic allochems; very abundant miliolids; very dolomitic; medium crystalline dolomite; micrite matrix completely replaced by dolomite; original limestone texture partially effaced by dolomitization; moderately burrowed; well developed honeycomb structure; tan to light brown.

114. 0.7′ Limestone: muddy biosparite; fine sand to small pebble size; moderately sorted; rounded to well rounded; 15% randomly oriented platy pelecypod fragments; abundant miliolids; very abundant small to medium pebble size snails and clams; very abundant *Nerinea* sp.; slightly burrowed with dolomitic burrow fill; buff with tan mottles.

115. 7.5′ Covered and calichified. No description.

116. 1.5′ Dolomitic limestone: packed biomicrite to slightly muddy biosparrudite; fine to very coarse; occasional coated grains; moderately to well rounded biogenic

allochems; very abundant miliolids and miliolid fragments; very abundant granular to small pebble size gastropods, most of which are leached out leaving large pores; gastropods are high spired and parallel to bedding; occasional echinoid fragments; very high leached allochem and intergranular porosity; yellow-brown to light brown.

117. 0.5′ Dolomitic limestone: packed biomicrite with bored fossiliferous micrite cap; fine to very coarse; moderately sorted; well rounded; abundant miliolids and miliolid fragments; extremely dolomitic; fine to medium crystalline dolomite; original limestone texture partially effaced by dolomitization; bore holes are filled with material of same composition as underlying biomicrite; bore holes are 1/8″ in diameter and are spaced approximately 3/8″ apart; packed biomicrite in lower part is yellow-brown; fossiliferous micrite portion in cap is gray.

118. 2.2′ Limestone: packed biomicrite to muddy biosparite; medium to very coarse; allochems are rounded to well rounded; occasional coated grains; frequent platy shell allochems oriented parallel to bedding, giving the rock a faint laminated appearance; abundant intraclasts up to 2″ in length; 20-40% of the allochems are miliolids; slightly dolomitic in patches; massive; light tan.

119. 2.5′ Limestone: packed biomicrite to muddy biosparite; fine to very coarse; subrounded to well rounded allochems; moderately sorted; 5% of the allochems are randomly oriented platy pelecypod fragments; 10% of the allochems are yellow-brown stained; abundant coated grains; very abundant miliolids and other foraminifers; occasional sparry gastropods; packed biomicrite occurs as patches in muddy biosparite; slightly to moderately burrowed; moderately well developed honeycomb structure; light brown to tan.

120. 1.3′ Limestone: slightly muddy biosparite; fine to granular; poorly sorted; 20-30% of the allochems are randomly oriented pelecypod fragments; occasional miliolids; slightly to moderately burrowed; some sparry calcite vug filling; moderately well developed honeycomb structure; light tan.

121. 0.5′ Limestone: slightly muddy biosparite; fine to coarse; poorly sorted; 2% of the allochems are iron stained; abundant miliolids; laminated; massive; tan to buff.

122. 1.0′ Limestone: packed biomicrite to well washed biosparite; medium to granular; subrounded to well rounded; well sorted; frequent coated grains; very abundant reddish-brown hematite spots; occasional miliolids; very fossiliferous; abundant high spired gastropods; very abundant oysters and other pelecypods; abundant *Monopleura* sp.; abundant *Nerinea* sp.; brown.

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123. —— Marl: fossiliferous micrite; coarse to granular; very fossiliferous with abundant *Exogyra texana*, occasional large clam steinkerns; frequent to abundant randomly oriented pelecypod fragments; extensively burrowed; medium nodular bedded.

MEASURED SECTION 8

Measured Section 8 is near the eastern margin of the thesis area about 1.2 miles southeast of Wimberley.

1. 1.5′ Limestone: slightly muddy biosparite; fine to very coarse; poorly sorted; abundant miliolids; sparry vug filling; massive.

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2. 10.7′ Marl: sparse biomicrite; fine to granular; very fossiliferous with abundant *Exogyra texana*, randomly oriented pelecypod fragments, gastropods, small to large clam steinkerns; intensely burrowed; thin bedded; faintly to well mottled.

TOP OF THE BEE CAVE

3. 1.5′ Limestone: biogenic muddy intrasparite; medium to very coarse; moderately sorted; abundant biogenic allochems; most of the biogenic allochems are coated and well rounded; abundant platy shell allochems moderately well oriented parallel to bedding, giving the bed a faint laminated appearance at its base; frequent miliolids; occasional glauconite grains.

4. 1.5′ Limestone: intraclastic sparse biomicrite to packed intramicrite; medium to very coarse; poorly sorted; up to 40% of the allochems are light brown intraclasts; intraclast content increases upward.

5. 1.8′ Covered. No description.

6. 1.8′ Limestone: biosparite; medium to coarse; well sorted; subrounded to well rounded; 10% light brown allochems; frequent miliolids and other foraminifers; faintly laminated in upper part; buff.

MEASURED SECTION 9

Measured Section 9 is about 0.3 miles east of the eastern margin of the thesis area about 1.6 miles southeast of Wimberley and about 0.3 miles east of Measured Section 7b.

1. ——— Limestone: intraclastic biosparite: medium to granular; unsorted; rounded to well rounded; intraclasts are of small pebble size; abundant miliolids; occasional small pebble size oyster fragments; massive; tan to buff; weathers medium gray.

2. 6.1′ Dolomitic limestone: packed biomicrite to muddy biosparite; medium to very coarse; abundant coated grains; abundant miliolids and other foraminifers; very dolomitic; medium crystalline dolomite; original limestone texture partially effaced by dolomitization; slightly to moderately burrowed; porous dolomite burrow fill; massive; lumpy; light yellow-brown to tan; weathers medium gray.

3. 1.1′ Limestone: slightly muddy biosparite; fine to coarse; unsorted; rounded to well rounded; abundant light brown stained allochems; frequent intraclasts; abundant miliolids and other foraminifers; slightly dolomitic; medium crystalline dolomite; massive; light tan; weathers medium gray.

4. 1.7′ Limestone: intraclastic slightly muddy biosparite; medium to coarse; moderately sorted; rounded to well rounded; abundant reddish-brown hematite spots; occasional miliolids; very fossiliferous with abundant small pebble size oyster fragments, abundant high spired snails, including *Nerinea* sp., and abundant thick walled pelecypod fragments; slightly to moderately burrowed, with packed biomicrite burrow fill; massive; reddish to dark yellowish-brown; weathers reddish to dark yellowish-brown.

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5. 10.5′ Marl: calcareous mudstone to fossiliferous micrudite; up to 30% terrigenous mud; slightly glauconitic; abundant *Exogyra texana* interspersed throughout; occasional medium size clam and snail steinkerns; apparently intensely burrowed; medium nodular bedded; buff to light tan; weathers buff to light tan.

TOP OF THE BEE CAVE

6. 0.5′ Limestone: muddy biosparite; medium to coarse; grain size increases to granular at top; unsorted; 25% light brown allochems; abundant granular to small pebble size oyster fragments oriented parallel to bedding; massive; light brown and tan with reddish-brown mottles.

7. 5.8′ Dolomitic limestone: packed biomicrite; medium to coarse; abundant light reddish-brown iron stained allochems; very abundant whole and fragmented

oysters at base; very fossiliferous at base; moderately dolomitic; medium crystalline dolomite; intensely burrowed; becomes moderately burrowed with extremely dolomitic burrow fill toward top; massive; lumpy; tan to buff; becomes white with light brown mottles toward top.

8. 2.3′ Dolomitic limestone: packed biomicrite to slightly muddy biosparite; fine to coarse; moderately sorted; frequent platy shell allochems oriented parallel to bedding, giving the rock a faint laminated appearance; frequent yellow-brown intraclasts; abundant miliolids; extremely dolomitic; medium crystalline dolomite; saccharoidal; micrite matrix completely replaced by dolomite; original limestone texture partially effaced by dolomitization; burrowing increases upward from slight to moderate; massive; buff to tan; weathers medium gray.

9. 2.8′ Marl: sparse biomicrite; medium grained; contains much terrigenous mud; intensely burrowed; very thin nodular bedded; light yellow-brown; weathers light yellow-brown.

10. 2.0′ Dolomite: medium crystalline; saccharoidal; 10% leached allochem porosity; relict texture indicates packed biomicrite; frequent yellow-brown stained leached allochem pores; abundant coarse sand size reddish-brown hematite spots; moderate burrowing causes poorly developed honeycomb structure; light brown; weathers light gray to tan.

MEASURED SECTION 10

Measured Section 10 is on the west side of Texas F.M. 12 about 2.3 air miles south of Wimberley.

1. —— Dolomite: medium to coarsely crystalline; collapse breccia features indicate previous presence of gypsum; medium bedded; shows relict algal mat structure; light brown to reddish-brown; weathers dark gray to black.

2. 1.3′ Dolomite: medium crystalline; well developed collapse breccia and undulatory bedding; thin bedded; light brown to tan; weathers dark gray to black.

3. 2.0′ Pulverulite?: thin to medium undulatory bedded; contains many veins of finely to very coarsely crystalline calcite; probably evaporitic in origin; abundant dissolved gypsum collapse features; vuggy; light reddish-brown; weathers light reddish-brown.

4. 1.6′ Pulverulite?: medium undulatory bedded; abundant coarsely to very coarsely crystalline calcite veins; abundant solution collapse features; probably evaporitic in origin; very vuggy; lumpy; gray to light brown; weathers white to dark gray.

5. 2.8′ Extremely dolomitic limestone: original limestone texture nearly effaced by dolomitization; medium crystalline dolomite; porosity ranges from 0-10%; relict texture indicates muddy biosparite; medium to very coarse; extremely abundant yellow-brown intraclasts; occasional relict laminations probably of algal mat origin; abundant miliolids and miliolid fragments; poorly developed collapse features near middle; medium bedded; tan to light brown with reddish-brown mottles; weathers tan to black.

6. 2.8′ Pulverulite?: covered and calichified; apparently a pulverulite bed laced with medium to coarsely crystalline sparry calcite veins; abundant vugs, collapse breccia and other evidences of solution.

7. 2.8′ Dolomite: medium crystalline; abundant coarse sand size allochems; frequent small reddish-brown hematite spots; laced with calcite veins and isolated 1″ to 4″ calcite nodules; relict laminated structure; massive with two thin bedded units in middle; light yellow-brown.

8. 7.6′ Pulverulite?: complexly interlaced with sparry calcite veins; contains occasional patches of dolomite; dolomite is medium crystalline; dolomite is light brown and weathers black; calcite is light brown with occasional bright reddish-brown spots.

19. 3.9′ Dolomitic limestone: miliolid bearing biosparite; fine to very coarse; well sorted; rounded to well rounded; frequent coated grains; occasional to abundant medium to large pebble size dolomitic intraclasts; slightly fossiliferous; very abundant miliolids and other foraminifers; very cavernous with small caves partially filled with terra rosa; laminated; medium bedded; light brown; weathers medium gray.

20. 3.7′ Limestone: muddy biosparite; medium grained; unsorted; 5% randomly oriented platy mollusc fragments; abundant whole and fragmented oysters dispersed throughout; moderately burrowed; massive; lumpy; tan; weathers medium gray.

21. 0.7′ Dolomitic limestone: packed biomicrite to muddy biosparite; medium to coarse; subrounded to well rounded; frequent yellow-brown intraclasts; 2% of the allochems are granular to small pebble size platy pelecypod fragments; occasional rudists; abundant miliolids and other foraminifers; slightly burrowed with porous packed biomicrite burrow fill; poorly developed honeycomb structure; massive; tan with yellow-brown mottles; weathers medium gray.

22. 1.3′ Limestone: slightly muddy miliolid biosparite; medium grained; 10% miliolids; occasional spar filled vugs; massive; tan; weathers medium gray.

MEASURED SECTION 11

Measured Section 11 is near the southwest corner of the thesis area about 0.7 miles south of Texas F.M. 32 and 0.9 miles east of the west boundary of the area.

1. 1.0′ Limestone: intraclastic biosparite; medium grained; sorted; approximately 20% of the allochems are intraclasts; intraclasts are up to ½″ in diameter; occasional granular pelecypod fragments, probably oysters; slightly burrowed; massive; buff; weathers white to tan.

2. 3.5′ Limestone: muddy biosparite; fine to medium; unsorted; 20% reddish-brown allochems; occasional *Exogyra* sp.; moderately burrowed; massive to lumpy; light brown to tan; weathers light brown to tan.

3. 3.3′ Dolomite: medium crystalline; abundant reddish-brown iron stained ghost allochems; grades into calcareous dolomite upwards; light brown; weathers black; calichified.

4. 1.0′ Extremely dolomitic limestone: medium crystalline dolomite; saccharoidal; original limestone texture is almost completely effaced by dolomitization; relict texture indicates packed biomicrite; fine to coarse; abundant yellow-brown intraclasts; slightly porous with leached allochem porosity; moderate relict burrowing; massive and lumpy; buff; weathers buff.

5. 2.5′ Covered. No description.

6. 1.0′ Limestone: muddy to well washed biosparite; medium to coarse; moderately sorted; subrounded to well rounded; abundant randomly oriented platy shell allochems; medium to granular intraclasts; 10% of the allochems are miliolids and other foraminifers; frequent thick walled pelecypod fragments; laminated; massive; buff to light tan; weathers gray to black.

7. 3.5′ Dolomitic limestone: packed biomicrite to muddy biosparite; fine to very coarse; 10% of the allochems are iron stained; 5% are randomly oriented platy shell allochems; abundant miliolids and other foraminifers; occasional randomly oriented pelecypod fragments; very dolomitic; medium crystalline dolomite; low leached allochem porosity; moderately burrowed; white to light tan; weathers tan.

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8. 2.0′ Dolomitic limestone: packed oyster fragment biomicrite; medium to coarse grained; 10% of the allochems are iron stained; abundant *Exogyra texana*; very dolomitic; intensely burrowed; nodular to lumpy; brown to white.

9. 1.3′ Extremely dolomitic limestone: original limestone texture partially effaced by dolomitization; faint relict texture indicates packed biomicrite; medium to coarse; slightly glauconitic; medium crystalline dolomite; saccharoidal; moderately burrowed; tan to yellow-brown; weathers black to buff.

10. 7.1′ Marl: fossiliferous micrudite; sand size allochems not visible; *Exogyra texana* occurs in restricted zones; tan; covered and calichified.

TOP OF THE BEE CAVE

11. 1.4′ Dolomitic limestone: packed biomicrite; fine to coarse; unsorted; 10% of the allochems are iron stained; frequent randomly oriented platy shell allochems; abundant yellow-brown medium sand size intraclasts; occasional dark reddish-brown hematite spots; occasional thick walled pelecypod fragments; original limestone texture partially effaced by dolomitization; moderately burrowed; massive with poorly developed honeycomb structure; light brown to tan.

12. 4.5′ Marl: covered and calichified; apparently a medium grained packed biomicrite.

13. 1.0′ Limestone: biosparite; very fine to fine; sorted; rounded; 30% of the allochems are light brown stained; buff to tan.

14. 1.5′ Dolomitic limestone: packed biomicrite to slightly muddy biosparite; medium grained; very well sorted; subrounded to well rounded; occasional coated grains; frequent reddish-brown allochems; 3-5% of the allochems are mollusc fragments; slightly dolomitic; medium crystalline dolomite; slightly burrowed with porous very dolomitic biomicrite burrow fill; buff.

15. 15.7′ Dolomite: medium crystalline; abundant reddish-brown iron stained ghost allochems; abundant spar filled veinlets; extensively burrowed; massive; lumpy; nodular where weathered; light grayish-brown mottled.

16. 1.0′ Dolomitic limestone: muddy biosparite; medium to coarse; abundant light reddish-brown iron stained allochems; abundant *Toucasia* sp.; dolomitic; medium crystalline dolomite; mud content decreases upward; massive; light tan to buff; weathers grayish brown.

17. 0.8′ Dolomite: medium crystalline; saccharoidal; moderate porosity; relict texture indicates sparse to packed biomicrite; medium to very coarse; unsorted; frequent light brown iron stained alochems; abundant brown stained leached allochem holes; laminated and cross bedded; light tan to medium gray with tan mottles; weathers medium gray to black.

30. 3.0′ Calcareous dolomite: fine to medium crystalline; original limestone texture almost completely effaced by dolomitization; relict texture indicates sparse biomicrite; medium to coarse; unsorted; occasional platy shell allochems; frequent light brown allochems; occasional miliolids; occasional small clams; intensely burrowed; medium to coarse packed biomicrite burrow fill; massive; light gray to buff; weathers medium gray.

31. 3.0′ Limestone: largely recrystallized from weathering; appears to be a packed biomicrite; fine to medium; abundant medium to granular pelecypod and gastropod fragments; massive; light gray to white; weathers medium gray.

32. 8.0′ Limestone: partially recrystallized from weathering; probably was originally a muddy biosparite; medium grained; abundant platy mollusc fragments; low leached allochem porosity; poorly developed honeycomb structure; light brown to tan; weathers dark gray; covered and calichified.

33. 2.0′ Limestone: partially recrystallized from weathering; moderately burrowed; burrow fill has high leached allochem porosity.

34. 7.0′ Covered: grass and float covered slope; float indicates probable recrystallized limestone containing chert. Chert is knobby, irregular, and rounded, with no apparent bedding control; light grayish blue with white patina; concentrically banded near the edges; contains miliolids and other biogenic allochems.

35. 1.0′ Limestone: recrystallized from weathering; biosparite; 5% of the allochems are platy mollusc fragments oriented parallel to bedding, giving the rock a faint laminated appearance; massive; light gray; weathers medium gray.

36. 2.0′ Limestone: partially recrystallized from weathering; moderately burrowed with packed biomicrite burrow fill and sparse biomicite unburrowed portion; light gray to tan; weathers medium gray.

37. 1.5′ Limestone: muddy intraclastic biosparite; medium to very coarse; 1% granular to small pebble size intraclasts; most are light brown iron stained; abundant platy mollusc fragments moderately well oriented parallel to bedding; massive; light gray; weathers medium gray; slightly recrystallized from weathering.

38. 4.5′ Calcareous dolomite: fine to medium crystalline; relict texture indicates fossiliferous micrite to sparse biomicrite; fine to coarse; very abundant thick walled platy pelecypod fragments oriented parallel to bedding; occasional orange intraclasts; frequent miliolids and miliolid fragments; moderately burrowed with coarse dolomitic burrow fill; massive; medium gray; weathers medium gray.

VITA

Thomas Walter Grimshaw was born in Chamberlain, South Dakota on March 23, 1945, the son of Phyllis Lorraine and Claude Walter Grimshaw. He attended several public schools in South Dakota and was graduated from Washington Senior High School, Sioux Falls, South Dakota, in June, 1963. The following September he entered South Dakota School of Mines and Technology and was graduated from there in June, 1967, with a Bachelor of Science degree in Geological Engineering. He entered the Graduate School of the University of Texas at Austin in September, 1967, to pursue study for a Master of Arts degree in Geology. He was the recipient of an NDEA Title IV fellowship during his study for that degree. He was married in September, 1969, to Susan Stein of San Antonio, Texas.

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