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## *Wolfcampian upper Hueco Formation of the Robledo Mountains, Dona Ana County, New Mexico*

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# WOLFCAMPIAN UPPER HUECO FORMATION OF THE ROBLEDO MOUNTAINS, DONA ANA COUNTY, NEW MEXICO

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## INTRODUCTION

The Robledo Mountains are located in central Dona Ana County in south-central New Mexico. The mountains are a wedge-shaped horst of Paleozoic sedimentary rocks (Lower Ordovician-Lower Permian) and Cenozoic clastic, volcanic, and intrusive rocks that are tilted about 10 to 15 degrees to the south. The low cuestas in the southern and central part of the range expose the upper part of the Hueco Formation of Wolfcampian age.

Kottlowski mapped the regional general geology and measured the stratigraphic column in his Las Cruces Quadrangle study (1960a). His measured section of the Hueco Formation is given as 1,715 ft. This thickness excludes the Wolfcampian Bursum Formation of 190 ft which should probably be included with the Hueco Formation in the Robledo Mountains (1,905 ft total adjusted Hueco Formation). Jordan (1971), who measured 175 ft of Bursum Formation, included this sequence in his Hueco Formation and arrived at a total thickness of 1,864 ft. W. R. Seager has completed the detailed general geology of the Robledo Mountains and has measured a section of the Hueco Formation that approximates Jordan and Kottlowski's figures (Seager, personal communication, 1974). All workers have informally divided the Hueco into lower, middle, and upper members with a tongue of the Abo Formation occurring between the middle and upper members.

An exceptional silicified phylloid algal bank was discovered in the upper member at the Shalem Colony section (sec. 19, T. 22 S., R 1 E.) in the summer of 1967 (LeMone and others, 1967). The study of this bank and the subjacent 275 ft of the Abo tongue was followed by a megafaunal and microfacies analysis (LeMone and others, 1971). This study has expanded into a rigorous examination of the megafaunal and lithologic relationships of the Abo tongue and upper Hueco member in the Robledo Mountains and other ranges in south-central New Mexico. A regional detailed examination of the entire Hueco Formation problem in Dona Ana County and areas to the south and west was initiated during the summer of 1974. This study will include the establishment of a transitional Abo-Hueco stratotype in the Robledo Mountains. This paper summarizes the progress on this problem to May, 1975 and is confined to a discussion of the Abo tongue and upper Hueco member in the Robledo Mountains.

## PALEOGEOGRAPHIC RELATIONSHIPS

The upper Hueco Formation was deposited on the Robledo shelf during Wolfcampian time. The Robledo shelf is the general term utilized for the western shelf margin of Orogrande basin in Pennsylvanian and Permian time. The Orogrande basin (Pray, 1959) has been defined as approximating the position of the modern day Tularosa Basin or Valley. The

eastern margin appears to be valid. The configuration of the western margin is currently in the process of reevaluation. The Florida islands or archipelago were a series of small, scattered positive elements west of the Robledo shelf and separated the Florida shelf of the Pedregosa basin from the Robledo shelf. The Florida archipelago is centered along the northwest-trending persistent Paleozoic structure defined by Kottlowski (1960b) as the Florida uplift. The term Potrillo shelf was substituted for the Robledo shelf by Wengerd (1969), but the older term Robledo shelf is preferred for Wolfcampian sequences.

The source area for the siltstone and very fine sandstone of the continental Abo facies is north and west of Robledo Mountains. This relationship is clearly developed by Meyer (1966). The typical Abo continental red-bed facies therefore shows a correspondingly larger influence in sections exposed north of the Robledo Mountains. A similar development has been documented in the Sacramento Mountains, which are paleogeographically along the Sacramento shelf on the eastern side of the Orogrande basin. Wolfcampian sections in the Franklin Mountains (located 30 to 35 mi south of the Robledo Mountains on the eastern or southern [Jordan, 1971] margin of the Robledo shelf) conversely are primarily composed of marine carbonate strata, which indicates a progressive decrease in the influence of Wolfcampian Abo facies sedimentation in the south away from the source area.

## AGE AND GENERAL STRATIGRAPHIC RELATIONSHIPS

One primary purpose of the detailed megafaunal analysis of the Abo tongue and upper Hueco member has been to establish their ages. Age determination in the Pennsylvanian and Permian carbonate rocks has been axiomatically the prerogative of fusulinid specialists. The upper Hueco member and Abo tongue both lack significant fusulinid faunas; however, a single fusulinid was found in the upper Hueco member (LeMone and others, 1967), but it clearly shows transport and redeposition. Jordan (1971) reports only one occurrence of fusulinids in the upper Hueco and none in the Abo tongue.

No evidence of fauna or flora younger than Wolfcampian in age in the Paleozoic has been recovered from the Robledo Mountains. Evidence for an upper Wolfcampian age of the Abo tongue and upper Hueco member in the Robledo Mountains are indicated by the invertebrate fauna; they include:

Porifera: *Wewokella (Talpaspongia) clavata*  
(R. H. King)

Brachiopoda: *Linoproductus cora* (d'Orbigny)  
*Canrinella altissima* R. H. King  
*Squamaria moorei* Muir-Wood and  
Cooper  
*Costellarina costellata* (Muir-Wood  
and Cooper)

	<i>Pontisia franklinensis</i> (Cooper and Grant)
	<i>Beecheria bovidens</i> (Marcou)
Gastropoda:	<i>Euphemitopsis multinodosa</i> Yochelson
	<i>Straparollus (Euomphalus)</i> corn ud an us (Shumard)
	<i>Omphalotrochus obtusispira</i> (Shumard)
Cephalopoda:	<i>Akmlilleria huecoensis</i>
	Miller and Furnish
	<i>Properrinites denhami</i> Miller and Furnish
Scaphopoda:	<i>Plagioglypta</i> cf. <i>P. canna</i> (White)
Bivalvia:	<i>Septimyalina burmai</i> (Newell)
	<i>Pteronites peracuta</i> (Shumard)
	<i>Wilkingia terminate</i> (Hall)

The Wolfcampian sequence in the Robledo Mountains has been divided in ascending order into the Bursum Formation and the Hueco Formation, the latter of which was informally divided into lower, middle, upper members and the Abo tongue by Kottlowski (1960a). Seager (personal communication, 1974) and Jordan (1971) recognize the four units and retain Kottlowski's Abo clastic unit as a tongue. The Abo tongue comprises primarily symmetrical and asymmetrical cyclic deposits of nonmarine fine sandstone, siltstone, and mudstone (Abo facies) alternating with marine calcareous shale and limestone (Hueco facies). The Abo facies is interpreted as prograding subaerial deltas. The Abo facies has yielded lower vertebrate trackways, megafloreal remains, and mudcracks in the Shalem Colony area.

#### Microfacies Analysis

Microfacies analysis of the 326.4 ft of the upper part of the Abo tongue and lower beds of the upper Hueco member at the Shalem Colony section develop easily separable carbonate sequences (LeMone and others, 1971).

The cyclic 45 ft (Hueco I) Hueco or carbonate facies of the Abo tongue consists of mud-supported ostracod biomicrite (wackestone) with a lack of foraminifera and other stenohaline fossils (shallow water, brackish water conditions) which grades up into a grain-supported foram-ostracod biomicrite (packstone) with a few gastropods, bryozoa, crinoids, and echinoid spines. The foram-ostracod biomicrite has intraclasts indicating occasional turbulence (shallow-water, normal marine conditions). The top of the Hueco I facies grades back into an ostracod biomicrite with transported stenohaline invertebrate debris, indicating symmetrical cyclicity as it abruptly changes into a siltstone with calcareous cement in the overlying 60 ft thick Abo II facies.

The cross-bedded clastic Abo II facies grades up into a fossiliferous ostracod micrite (mudstone) at the base of 82 ft of Hueco II carbonate. The Hueco II unit is largely composed of mud-supported biomicrudite (wackestone) with a diversified invertebrate faunal and paleophycological floral assemblage *Epimastopora* (Dasycladacea); phylloid algal blades (Codiaceae) are also present. The unit is interpreted to have been deposited in shallow (less than 15 ft), quiet water in a normal marine environment. The contact with the overlying 28 ft of Abo III facies is a sharp, irregular, distinct discontinuity indicating at least a partially asymmetrical cycle.

The transition from Abo III, which is the upper unit of the Abo tongue, to Hueco III, which is the lowest part of the upper Hueco member, is a sharp, irregular discontinuity.

The 75.4 ft of Hueco III facies varies from mudstone to grain-supported biomicrite and biomicrudite (wackestone to

packstone). A biostromal phylloid algal bank (0.5 ft thick) is present 2.5 ft above the base of Hueco III and indicates shallow, quiet water and normal marine salinity. The algae is in association with a diversified, stenohaline fauna. Dasycladaceans are represented by *Epimastopora* primarily. Fauna is coated by the blue-green algae genus *Girvane/la*. The diversified marine fauna includes rich assemblages of ophthalmid, endotheid, and encrusting foraminifera. Recent ophthalmid foraminifera are typically found in shallow water of 6 to 12 ft. Recrystallization is common. The facies indicate shallow water on an open shelf, in wave-sheltered situations with normal salinity.

#### PALEOENVIRONMENTAL ANALYSIS

The Abo tongue and upper Hueco member have yielded a prolific invertebrate fauna of several thousand specimens including: Porifera (1 species), Bryozoa (4 species), Brachiopoda (11 species), Bivalvia (14 species), Scaphopoda (1 species), Gastropoda (20 species), Cephalopoda (6 species), Echinoidea (1 species), Crinoidea (2 species), Polychaeta (1 species), and Arthropoda (Stracoda and acrothoracic Cirripedia). Ichnological analysis is in progress.

Terrestrial higher plants (Abo clastic facies) and marine algal forms (Hueco carbonate facies) are well documented in megafaunal and microfloral analyses. Lower vertebrate trackways and numerous mudcrack horizons have been recorded from the Abo tongue, which documents the partial subaerial condition of this unit.

Stevens (1963, 1966) developed eight megafaunal Wolfcampian communities based on turbidity, salinity, energy, and depth parameters. These communities, as well as two others, are recognizable with special variations in the Robledo Mountains. They are defined as deltaic, ostracod, euphemitid, nuculanid, *Costellarina*, chonetid, *productid-Composita*, gastropod, fusulinid, and paleotextularid. The fusulinid and paleotextularid communities are not recognized in the upper portion of the Hueco Formation in the Robledo Mountains but are present in the Hueco and Franklin Mountains. All communities, with the exception of the deltaic-tidal flat and ostracod, are patterned after Stevens (1966). Fauna listed are the most common forms for the community.

- I. Deltaic-tidal flat community (Abo tongue-clastic facies)  
The community is defined by red, cross-bedded, laminated fine sand, silt, and clay. It contains terrestrial megaflorea and lower vertebrate trackways. Mudcracks are infrequently observed. It is subaerial and subaqueous.
- II. Ostracod community (Abo tongue carbonate facies)  
This community is typified by ostracod mudstone. It indicates variable (brackish) salinities to normal marine; energy can range from high to low; turbidity ranges from high to low. It is interpreted to be a very shallow (0 to 3 ft) nearshore facies. Ostracods tend to be smooth.
- III. Euphemitid community (Abo tongue carbonate facies)  
This community is defined as having a normal marine salinity, low to high energy, moderate to high turbidity, and a depth range of 0 to 12 ft.

Fauna: *Euphemitopsis multinodosa* Yochelson  
Unornamented ostracods  
*Septimyalina burmai* Newell

- IV. Nuculanid community (Abo tongue carbonate facies)  
This community is defined by having normal marine salinity, high to low energy, moderate to high turbidity, and a depth of 3 to 15 ft.  
Fauna: *Nuculopsis levatiformis* (Walcott)  
*Wilkingia terminale* (Hall)  
*Schizodus texanus* Clifton  
*Pteronites peracuta* (Shumard)
- V. *Costellarina* community (Abo tongue carbonate facies)  
The *Costellarina* community is defined as having normal marine salinity, low to high energy, moderate to high turbidity, and a depth of 6 to 21 ft.  
Fauna: *Costellarina costellata*  
(Muir-Wood and Cooper)  
*Crurithyris guadalupensis*  
(Girty)  
*Plagioglypta* cf. *P. canna*  
(White)
- VI. Chonetid community (Hueco Formation-Franklin and Hueco Mountains)  
This community with its special environmental parameters is not recognized in the Robledo Mountains. It is defined by having variable to normal salinity, low energy, high turbidity, and 12 to 30 ft in depth.  
Fauna: chonetid brachiopods  
bivalves  
productid brachiopods  
crinoid columnals
- VII. Productid-Composita community (Abo tongue carbonate facies and upper Hueco member)  
This community is defined as having variable to normal salinity, moderate to high energy, low to moderate turbidity, and occurs in a depth of water between 12 to 30 ft.  
Fauna: *Squamaria moorei* Muir-Wood  
and Cooper  
*Pentagonocyclopa* cf. *P. dispar* Moore  
*Pontisia franklinensis* Cooper  
and Grant  
*Composita mexicana* (Hall)  
*Beecheria bovidens* (Morton)
- VIII. Phylloid algae and coral (gastropod) community (upper Hueco member)  
This community is defined by normal marine salinity, low to moderate energy, low turbidity, and a depth range of 21 to 90 ft. Corals are rare in Robledo community, but gastropods are common and probably grazed on the prolific algae.  
Flora: Phylloid algae  
Fauna: *Wewokella* (Talpaspongia) *clavata*  
(R. H. King)  
*Straparollus* (*Euomphalus*) *cornudanus* (Shumard)  
*Omphalotrochus obtusispira*  
(Shumard)  
*Astartella subquadrata* Girty
- IX. Fusulinid community (possibly uppermost Hueco member)  
The fusulinid community is defined by normal marine salinity, low energy, low to moderate turbidity, and a depth of between 60 to 150 ft. This community is well developed in the Hueco and Franklin Mountains.  
Fauna: fusulinids  
bryozoans  
productid brachiopods  
*Omphalotrochus*
- X. Textularid community (not observed in the Robledo Mountains upper Hueco sequence)  
This community is defined by normal salinity, low energy, low turbidity, and occurs at depths of greater than 150 ft.  
Fauna: *Cribrogenerina*  
*Climacammina*  
*Cribrostomium*  
*Globivalvulina*  
*Geinitzina*
- The Abo tongue is represented by the six separate communities, one terrestrial (deltaic-tidal flat) and five brackish to marine (ostracod, euphemitid, nuculanid, *Costellarina* and productid-Composita). The marine units range from tidal to a maximum of 15 ft brackish to normal marine salinity, probably moderate to high energy, and most likely moderate turbidity.
- The Upper Hueco member is primarily composed of the phylloid algae-coral (gastropod) community of normal salinity (stenohaline forms common), low energy, and low to moderate turbidity. This fauna is interpreted as being very shallow, probably less than 30 ft, but not less than 12 ft. The fusulinid community may be present, but its occurrence would seem to be highly unlikely.

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