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BARITE DEPOSITS AT SEVEN HEART GAP, APACHE MOUNTAINS, CULBERSON COUNTY, TEXAS

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INTRODUCTION

Seven Heart Gap, as generally defined, is an area about 3 km long north-south and 5 km wide east-west located at the junction of the Delaware Mountain trend and the Apache Mountains. The area is about 16 km east of the eastern margin of the Salt Basin graben, about 60 km (35 road miles) northeast of Van Horn via Ranch Road 2185. The principal area of interest is the extreme southern part of Seven Heart Gap, especially that area in the low topographic divide between Gap Butte and the west central Apache Mountains on sections 5, 6, 7 and 8, PSL Block 62.

Barite was discovered in Seven Heart Gap sometime prior to 1930, and the occurrences were first explored in shallow, hand dug pits and trenches. First efforts to exploit the deposits were made by Continental Minerals in the late 1950's and early 1960's. A few thousand tons of barite ore were mined and hauled to Van Horn for processing. The operation proved uneconomic and was discontinued in the early 1960's. Brief descriptions of the barite occurrences are given by Evans (1945) and Wood (1968), and were described in more detail in a thesis by Murray (1978). Additional information about the barite deposits was generated by mapping and drilling done in 1978 and 1979.

GEOLOGY

Rock Units

Seven Heart Gap is on the northern flank of the Apache Mountains. The topographically highest parts of the western Apache Mountains are made up of the Capitan limestone which is considered part of the Permian Capitan barrier reef complex. Reef facies carbonate rocks constitute most of the northern half of the western Apache Mountains. Back-reef lagoonal carbonate and clastic sedimentary rock facies equivalent in age to the Capitan reef and shelf carbonate rocks older than the reef are exposed along the south flank of the Apaches. Along the northern flank of the mountains, restricted-basin sedimentary rocks and evaporites of the Castile and Rustler Formations overlap the reef and reef marginal rocks (fig. 1). Only in the immediate area of Seven Heart Gap, especially south of Gap Butte, is this sedimentary onlapping exposed. Faults form the northern margin of the Apache Mountains east and west of the gap and in those areas the northern margin of the reef is buried by colluvium.

Capitan reef limestone exposures are approximately 1 km south of the known barite occurrences at Seven Heart Gap. The Capitan is well described by Wood (1968) and is a massive, light gray limestone body with scattered dolomitized patches. A fore-reef talus locally interbedded with sandstone, siltstone, siltstone and brownish limestone characteristic of basin sedimentary rocks is spottily exposed along the northern margin of the reef. The reef fringing zone was mapped by Wood as Capitan transition facies, but was considered part of the Capitan lithosome. Transition facies rocks underlying the Castile Formation in the area of the barite occurrences were recognized in core holes. Bell Canyon Formation platy limestones and interbedded siltstones crop out in small, scattered exposures within 1.5 km northwest of the barite occurrences and in Gap Butte within 0.8 km of the nearest barite.

The Castile Formation in the Seven Heart Gap area has an aggregate thickness of about 100 m. The formation is relatively poorly exposed on slopes and underlies much of the topographic flats where it is shallowly covered by soil and alluvium. The basal 15 m or so of the Castile has the best surface exposures. It is a dark-

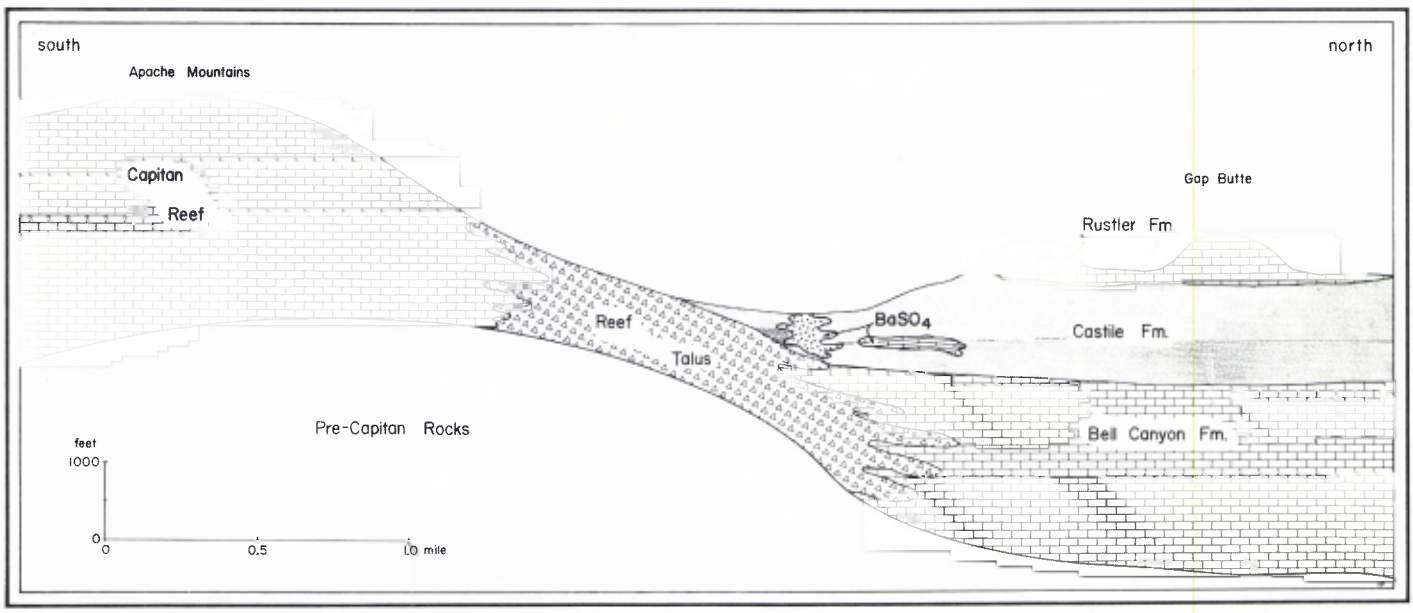


Figure 1. Diagrammatic cross section—Seven Heart Gap area, Culberson County, Texas.

colored, very thin-bedded, petroliferous limestone. Bedding laminae are separated by thin partings of secondary white calcite, at places as thick as the limestone laminae, giving this part of the Castile a distinctive banded appearance. Laminae are commonly distorted or brecciated. Limestone in the upper parts of the Castile are commonly recrystallized and vuggy so that few bedding laminations remain. The uppermost few meteors of the Castile, where preserved locally beneath a Rustler cap, is coarsely brecciated, recrystallized limestone set in a matrix of white calcite. (See Kirkland and Evans, this guidebook.)

Murray (1978) interpreted the Castile at Seven Heart Gap to be part of the Painthorse member. At its type section in central Culberson County, the Painthorse member is composed of limestone laminae separated by calcite and anhydrite layers ranging up to a few meters thick (Adams, 1944). No anhydrite or gypsum has been identified in the Castile in the vicinity of the barite occurrence at Seven Heart Gap, but structures within the Castile are suggestive of solution removal of evaporites.

The Rustler Formation, consisting of thick-bedded, locally brecciated dolomitic limestone and minor discontinuous limestone conglomerate beds, unconformably overlies the Castile Formation. The Rustler caps low hills in the Seven Heart Gap area and also occurs in scattered outcrops along the northern flank of the Apaches. As elsewhere in the Delaware Basin, the Rustler is characterized by locally complicated structures, including brecciated zones and by slumping and draping of beds due to solution of the underlying Castile.

Structure

Seven Heart Gap is the intersection of two pronounced structural trends—an easterly trend in the Apache Mountains dominated by the Capitan reef, and a north-northwesterly fault trend well developed along the western edge of the Delaware Mountains. In the vicinity of the barite occurrences, high-angle north-northwest-trending faults predominate. Apparent throw on the faults ranges from about 10 m to 100 m. Most of the barite occurrences in the southwestern part of the area are within a north-northwest-trending graben about 1000 m wide. However, not all of the barite occurrences are localized along faults, and in some exposures, high-angle north-northwest-trending faults are clearly younger than barite mineralization.

Deformation apparently related to solution is more pronounced and widespread than is high-angle faulting in Seven Heart Gap. Solution features include collapse breccia zones, local areas of steeply dipping beds, and small scale features such as contorted bedding and breccias. The large collapse breccia zones are characterized by jumbled blocks of laminated Castile limestone ranging from a few centimeters to several meters across, set in a matrix of coarse calcite and locally some barite and clay. Breccia zones are as much as 100 m across.

MINERALIZATION

Barite deposits and mineral occurrences are scattered over an area 2.5 km north-south by 5 km east-west along the north flank of the Apache Mountains and the south flank of Gap Butte. The best exposures of barite are in two pits in the northwest part of section 7. The larger pit is 30 m by 60 m by 10 m deep; the smaller pit, 215 m to the south, is 15 m by 12 m by 3 m deep. Most other barite exposures are in prospect pits or shallow trenches. Drilling of 78 holes on the property provided additional information about the distribution and nature of the barite occurrences.

Two modes of barite occurrence are distinguishable: (1) fine-grained replacement of selected, thin beds in essentially flat-lying Castile, and (2) massive replacement of the matrix in collapse breccia zones. These two types of occurrence are illustrated in Figure 2. Bedding-replacement deposits have been found over sizable areas independent of recognizable collapse breccia, but in places bedding replacements are gradational into collapse breccia deposits. Barite bands in the replacement deposits are parallel to bedding and range from hairline width to 3 cm; average thickness is about 1 cm. Fine-grained white calcite is in places intimately intergrown with barite. Limestone beds average 1 to 2 cm thick, and are unreplaced by barite. In a few places, vertical pull-apart fractures less than a centimeter wide in the limestone beds are filled by fine-grained barite. Larger replacement deposits identified in drilling are stratabound and occur within the lower 12 m of the Castile. The largest replacement deposit identified in drilling in section 5 covers a minimum area 215 by 100 m and averages about 3 m thick. Barite grades within the replacement zone average about 27 percent $BaSO_4$ and range from 15 to 38 percent through the mineralized intercepts.

Barite in collapse breccias is well exposed in the pits in section 7. A jumble of limestone clasts up to a meter in diameter are surrounded by a matrix of fine-grained white barite with varying amounts of intergrown fine-grained calcite. Barite filling the breccia matrix is texturally similar to that in the bedding replacement deposits. The principal difference is that barite in breccia zones occurs in larger masses with proportionately less limestone. Pods of nearly pure barite up to a meter across are present in some of the breccia zones. However, average barite grades for the breccia deposits and the bedding replacement deposits are about the same. Breccia ore in the pit in section 7 covers an area approximately 25 m by 35 m by 8 m thick. Barite in the breccia grades on the northeast, north and northwest sides into bedding replacement deposits which extend a minimum of 45 m outward from the margins of the breccia. Drilling showed that the solution-breccia barite deposit and adjacent bedding replacements are confined to a stratigraphic interval within 10 m of the base of the Castile Formation. Coarse-grained secondary calcite, in places with crystals as much as 3 cm across, occurs in irregular pods within or along the margins of collapse breccias. The calcite occurs mainly as matrix in breccia and to a lesser degree as fracture fillings. Coarse calcite matrix filling locally is gradational to fine-grained barite matrix fill. Pods of coarse calcite are relatively common in the Seven Heart Gap area, especially as residual calcite in surface outcrops. Calcite pods cover a much larger area than the known barite occurrences. Barite is not associated with many of the coarse calcite pods.

A limited number of geochemical analyses of the barite zones at Seven Heart Gap showed no enrichment above background for metallic elements Pb, Zn, Cu and Mn. Strontium in amounts to 0.8 percent is the only metal other than barium present in unusual amounts. Calcite, barite and minor celestite and clays are the only minerals identified in the deposits.

ORIGIN OF BARITE DEPOSITS

Inferences about the origin of barite deposits at Seven Heart Gap can be drawn based on geochemistry, mode of occurrence and stratigraphic position of the deposits. The lack of any metals other than Ba and Sr above background in the geochemical analyses, and lack of the common minerals fluorite, pyrite or any other sulfides argues against a hydrothermal origin for the barite. Selective barite replacement of laminae between limestone beds which probably were originally gypsum or anhydrite suggests that avail-

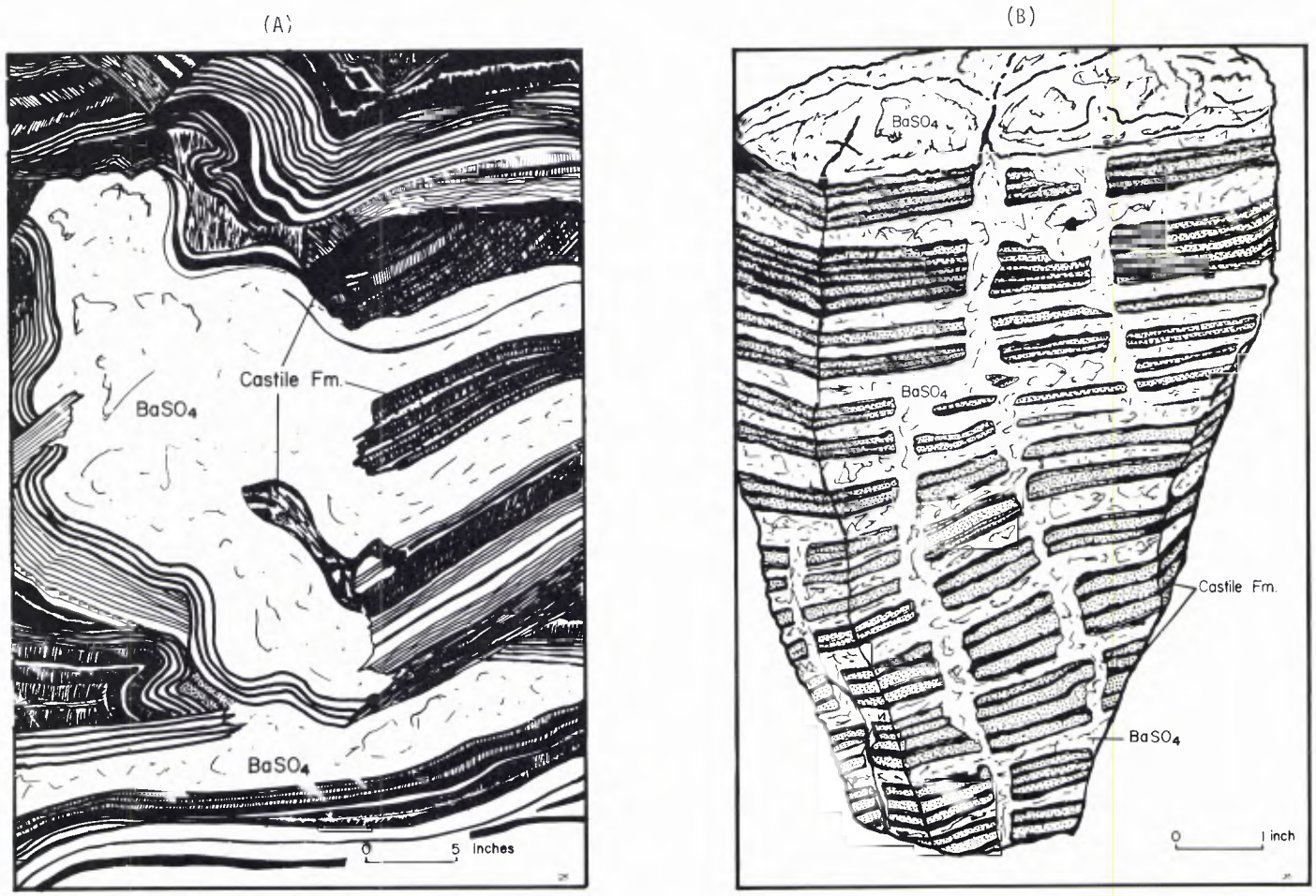


Figure 2. Modes of barite replacement at Seven Heart Gap: (A) massive replacement of the matrix of collapse breccia, (B) replacement of selected thin beds in the Castile Formation.

ability of sulfate was one of the controls of deposition. Textures of the barite deposits, especially the smaller scale breccia zones, are suggestive of barite formation after, or possibly synchronous with solution of interbedded evaporites. Connate waters, including brines as suggested by Murray (1978), are likely sources of barium. Barite deposition was probably effected by barium solubility changes related to mixing of fresh water with brines, or to reaction of barium-bearing waters from underlying formations with sulfates. Localization of barite in the lower part of the Castile may be a result of availability of fresh waters or barium-charged waters at that stratigraphic interval from aquifers in the closely underlying reef-margin rocks.

Drilling data show the barite deposits to be more consistent laterally and to be more stratabound than is evident in surface exposures. Localization of barite occurrences along north-northwesterly faults and fractures is not apparent in the drill data, and in some surface exposures these faults are demonstrably younger than the barite. Formation of the barite deposits appears to predate the Tertiary, north-northwest faulting, and could well have taken place any time between latest Paleozoic and mid-Tertiary time, a timing of events much older than envisioned by Wood (1968) or Murray (1978). Given the conditions of formation, especially the lack of control by Tertiary faulting, the possibility of other barite occurrences in geologically similar environments elsewhere in the Delaware Basin is good.

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Blue grama plant and spikelet, *Bouteloua gracilis*.