# Mesozoic(?) Rocks in the Baboquivari Mountains Papago Indian Reservation Arizona

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CONTRIBUTIONS TO STRATIGRAPHY

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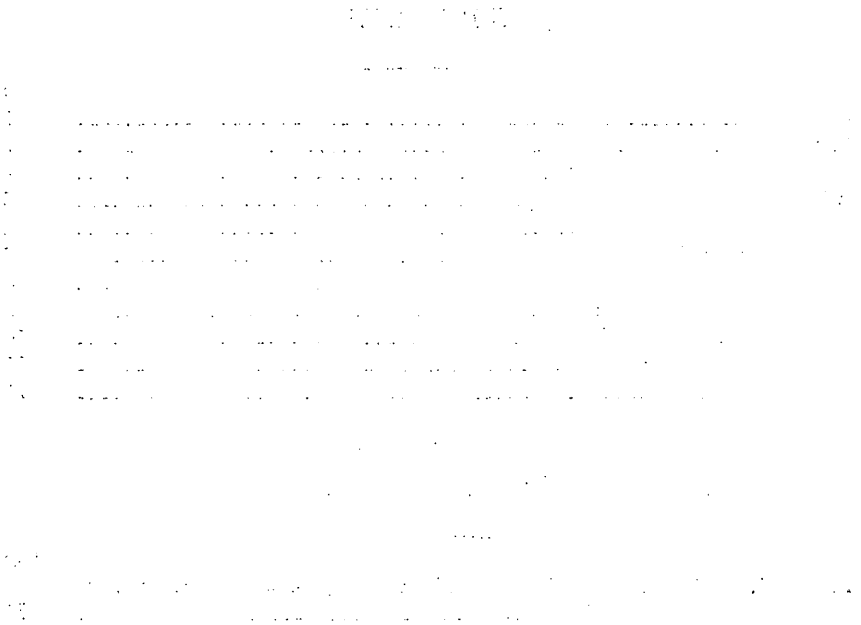

CONTRIBUTIONS TO STRATIGRAPHY

# MESOZOIC(?) ROCKS IN THE BABOQUIVARI MOUNTAINS, PAPAGO INDIAN RESERVATION, ARIZONA

By L. A. HEINDL and C. L. FAIR[1]

ABSTRACT

Rock of probable Mesozoic age in the west-central part of the Baboquivari Mountains include one metamorphic unit and three formations of sedimentary and volcanic materials. In ascending order, the formations are as follows: (1) The Pitoikam Formation, about 9,200 feet thick, comprising a lower conglomerate member made up mostly of graywacke, the Contreras Conglomerate Member made up mostly of fragments of pinkish quartz latite porphyry, and the Chiltepines Member made up mostly of maroon and green shale and arkose; (2) the Mulberry Wash Volcanic Formation, about 3,100 feet thick, comprising latite, quartz latite, and andesite flows and intercalated conglomerate; (3) and the Chiuli Shaik Formation, about 2,750 feet thick, comprising conglomerate, andesitic flows and breccias, and rhyolitic tuff. The Ali Molina Metamorphic Complex, whose stratigraphic relationships are uncertain, may include metamorphosed equivalents of the Pitoikam Formation. The Ali Molina is mostly massive flinty siliceous metasedimentary and metavolcanic rock.

The rocks are considered to be of Mesozoic age because they are similar to some Mesozoic rocks in nearby areas, are unlike rocks of Paleozoic or Precambrian age, and unconformably underlie deposits of probable Tertiary age.

## INTRODUCTION

This report is the third of three similar reports that briefly define and describe rocks of Mesozoic or probable Mesozoic age on the Papago Indian Reservation in south-central Arizona (fig. 1). The work on which this report is based was done in cooperation with the U.S. Bureau of Indian Affairs.

Rocks of Mesozoic or probable Mesozoic age crop out in many ranges in the eastern two-thirds of the reservation. In the central part of the Baboquivari Mountains in the southeastern part of the reservation, these rocks comprise a sequence nearly 20,000 feet thick;

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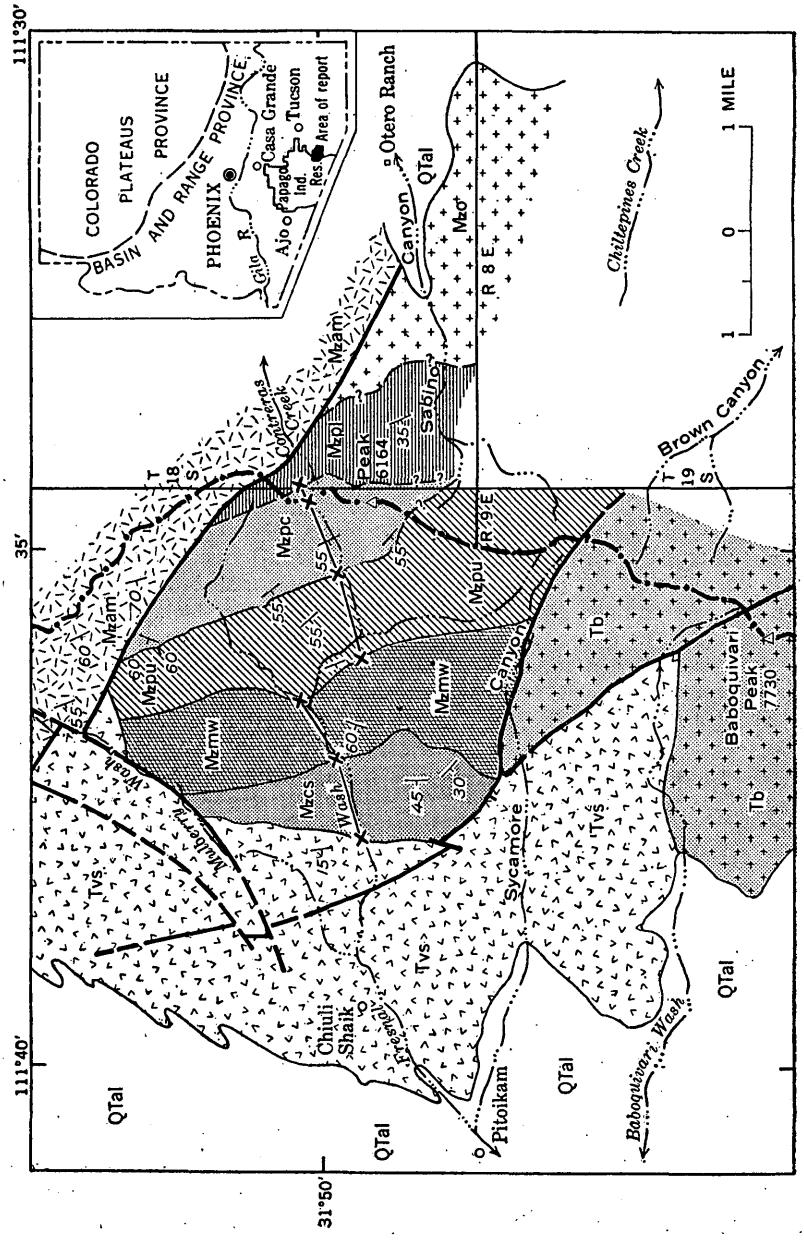
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35'
111°40'
31°50'
COLORADO PLATEAUS PROVINCE
BASIN AND RANGE PROVINCE
PHOENIX
Gila R.
Casa Grande
Ajo
Papago Ind. Res.
Tucson
Area of report
Otero Ranch
Canyon
QTal
Mam
Mpl
Peak 6164
Sabino
Mpc
Mpu
Mmw
Mcs
Mvt
Tvs
Tb
Wash
Chiuli Shaik
Sycamore
Pitoikam
Baboquivari Peak 7730
Chiltepines Creek
Brown Canyon
Baboquivari Wash
R 8 E
R 9 E
T 18 S
T 19 S
1 0 1 MILE

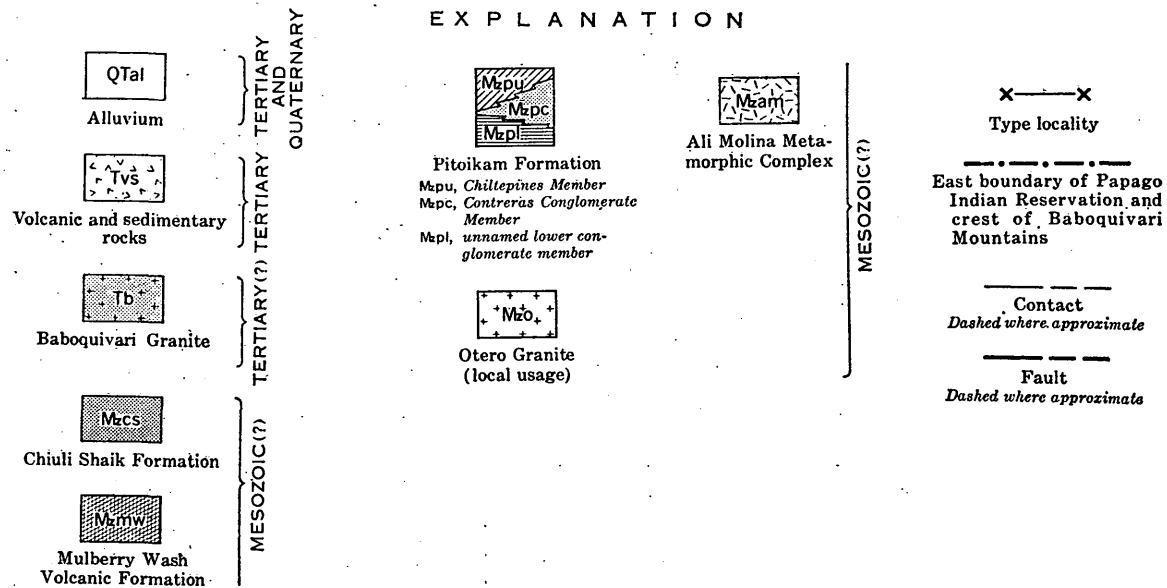


FIGURE 1.—Mesozoic(?) formations and generalized geology in the west-central part of the Baboquivari Mountains, Papago Indian Reservation, Ariz. Base from U.S. Geological Survey, Baboquivari Peak 15-minute quadrangle (1944). Geology by L. A. Heindl, 1957–59, and C. L. Fair, 1959–62; geology east of the crest of the Baboquivari Mountains after Donald (1958).

the beds in this sequence are composed of fine- to coarse-grained sedimentary fragments and of volcanic material of rhyolitic to andesitic composition.

This sequence in the Baboquivari Mountains appears to be of about one general age because (1) the formations of the sequence are nearly conformable, although a hiatus representing an interval of intrusive activity and erosion separates the lower and middle formations, and (2) because the three formations composing the sequence were deformed and eroded as a unit before being covered by Tertiary deposits. In a preliminary statement Fair (1961) suggested a Cretaceous and Tertiary age for this sequence, but subsequent radiometric dating of rocks from other parts of southern Arizona now makes a Tertiary age unlikely. The age of the sequence is now considered to be Mesozoic because (1) the rocks are similar in many respects, particularly lithologically, to other sequences of Mesozoic age; (2) the sequence contains a high proportion of volcanic materials unknown in the Paleozoic and younger Precambrian sequences; and (3) the sequence is separated from the overlying volcanic and sedimentary beds of presumed Tertiary age by a marked angular unconformity. The assignment of a Mesozoic age to the rocks, however, is tentative because no fossils were found in them; the sequence is nowhere in contact with deposits of known age; and the rocks of the sequence have not been dated radiometrically.

The Mesozoic(?) rocks in the central part of the Baboquivari Mountains are divided into four formations. The Ali Molina Metamorphic Complex is described first, although its stratigraphic relationships are uncertain, because it probably includes rocks which in part are older than those of the other three units. The three unmetamorphosed units, in ascending order, are the Pitoikam Formation, the Mulberry Wash Volcanic Formation, and the Chiuli Shaik Formation.

No correlation is attempted between the Mesozoic(?) units described in this report and those reported from the Vekol Mountains (Heindl, 1965a) and the Comobabi and Roskruge Mountains (Heindl, 1965b) on the Papago Indian Reservations and from the Tucson Mountains (Brown, 1939; Kinnison, 1959) and other nearby areas.

## OTHER ROCKS IN THE AREA

The Mesozoic(?) formations in the Baboquivari Mountains are in fault contact with all other rocks, except bedded deposits of Tertiary age and possibly the granite underlying the lowest unit (fig. 1). No Paleozoic or Precambrian rocks are known to be exposed in the area.

The Otero Granite, of local usage (Donald, 1958), appears to under-

lie the lowest conglomerate described in this report, but the nature of the contact is uncertain. A narrow zone of brecciated alaskite separates the conglomerate from the granite. According to Donald, the conglomerate either was deposited on the alaskite before the alaskite was brecciated or was deposited directly on the granite and then pried away from it by the intrusion of alaskite along the contact. The Otero Granite is mostly a gray medium-grained quartz-biotite porphyritic rock. The age of the Otero Granite is unknown; this granite is presumed to be of Mesozoic age and is older than the bedded formations described here.

The Baboquivari Granite is named for Baboquivari Peak which it constitutes; the formation is in fault contact with the Mesozoic(?) rocks along their southern boundary. This granite is a reddish coarse-grained porphyritic rock containing large orthoclase phenocrysts and conspicuous clusters of chlorite. Fragments of this granite are absent in the Mesozoic(?) units but are present in the lowest Tertiary conglomerate unit, which overlies disconformably the youngest Mesozoic(?) formation described from this area. On this basis, the Baboquivari Granite is considered to be of probable Tertiary age.

The Tertiary bedded rocks include volcanic conglomerate, andesitic flows, and rhyolitic tuff-agglomerate; some of the rocks are welded. These rocks rest disconformably on a surface cut on deformed beds of the Mesozoic(?) formations.

The alluvium is mostly of late Tertiary age and overlaps older Tertiary volcanic rocks in the area shown on figure 1. The alluvium includes lenticular beds of basalt near its base.

## ALI MOLINA METAMORPHIC COMPLEX

The main part of the core of the Baboquivari Mountains, like many ranges in the southeastern part of the reservation, consists largely or partly of slightly metamorphosed rocks. In the Baboquivari Mountains these rocks consist mostly of massive blue-gray flinty silicified sedimentary and volcanic material, and to a lesser extent of dark-gray to greenish-black phyllite, gray quartzite, and, locally, sericitic schist. Many sedimentary and volcanic textures and structures are clearly preserved, particularly in the massive flinty rocks. The top of the section is faulted and the base was not seen, but the attitude of the beds and the known width of outcrop—not all of which is shown on figure 1—suggest a total thickness of several thousand feet. These rocks weather almost uniformly to rugged steep ridges and canyons and form a convenient mappable unit, which here is named the Ali Molina Metamorphic Complex for its exposures along Ali Molina Canyon.

A partial section of the Ali Molina Metamorphic Complex is exposed

in and near Ali Molina Canyon 1 or 2 miles north of the area shown on figure 1. From east to west and in ascending order, a composite measured section includes at least 1,200 feet of gray to tan porphyritic andesite, latite, quartz latite porphyry, and rhyolite flow breccia; about 150–250 feet of gray arkosic quartzite and white quartzite; a 50-foot unit of greenish-gray pyroclastic or laharic material; and at least 300 feet of interbedded phyllite and phyllitic conglomerate.

The stratigraphic relationships of the Ali Molina cannot be demonstrated, except that the metamorphic complex is covered by either late Tertiary or Quaternary deposits. Where the contacts of the Ali Molina with other rocks have been observed, the relation is either one of faulting or intrusion. The Ali Molina, however, is considered to be of probable Mesozoic age because it contains volcanic rocks which do not occur in Paleozoic rocks in southern Arizona and because it is overlain disconformably by Tertiary rocks. In addition, the quartz latite porphyry of the Ali Molina is megascopically similar to the quartz latite porphyry of the boulders and smaller fragments of the Contreras Conglomerate Member of the Pitoikam Formation. This similarity suggests that possibly part of the Ali Molina may be a metamorphosed equivalent of the Pitoikam Formation.

## PITOIKAM FORMATION

The Pitoikam Formation is a unit about 9,200 feet thick on the upper slopes of the Baboquivari Mountains between the head of Fresnal Wash and Otero Ranch. This unit, named for the village of Pitoikam, is composed almost entirely of sedimentary rocks, mostly conglomerate and shale. The Pitoikam Formation strikes generally about N. 20° W. and dips about 60°–70° SW.

The contact between the Pitoikam Formation and the Otero Granite is described on page I 7. The contact between the Pitoikam and the overlying Mulberry Wash Volcanic Formation is nearly conformable, but it represents a hiatus. At least two facts indicate that the Pitoikam was eroded before the deposition of the Mulberry Wash Volcanic Formation: dikes intruding the Pitoikam do not cross the contact between the two formations but rather are truncated by it, and andesitic deposits at the top of the Pitoikam are cut out along the contact. The erosional nature of the upper contact is partly masked by slippage along bedding planes near the contact. The upper contact is well-defined because of manganese mineralization along the zone of slippage.

The Pitoikam Formation is divided into a lower conglomerate member; the middle Contreras Conglomerate Member; and the upper Chiltepines Member, consisting mostly of shale and arkose. These three

units constitute a single formation because they grade into each other. The measured sections of the Pitoikam Formation total at least 9,200 feet thick, but the formation appears to thin to the southeast where it passes out of the mapped area.

Aplitic, dacitic, and latitic dikes and sills intrude the Pitoikam Formation and form a striking pattern of irregular crisscrossing white stripes across the darker slopes of the rocks they intrude. These dikes do not extend into the overlying formation, and the break between it and the Pitoikan is a significant one although the two units are nearly conformable.

### LOWER CONGLOMERATE MEMBER

The lower conglomerate member of the Pitoikam Formation is the lowest unit of unmetamorphosed rocks of probable Mesozoic age in the area. The unit is a thick sedimentary sequence that crops out on the upper east slopes of the Baboquivari Mountains. The unit was first described by Donald (1958), who called it the Lower Conglomerate, or Conglomerate I, and the brief notes in this report are based largely on his work.

The basal contact of the lower conglomerate member roughly parallels a narrow band of brecciated alaskite which separates it from the Otero Granite. According to Donald, this conglomerate either was deposited on the alaskite before the alaskite was brecciated or was deposited on the Otero Granite, after which the alaskite was intruded along the contact and then brecciated. The lower conglomerate member apparently grades upward into the Contreras Conglomerate Member, but the contact is masked by slippage along bedding planes and possibly by small strike-slip faults.

The lower conglomerate member of the Pitoikam Formation is composed of alternating beds of blue-gray to red conglomerate, sandstone, and siltstone. Most of the pebbles, cobbles, and boulders are composed of volcanic materials but some are composed of limestone and quartz. The matrix commonly has the composition of a graywacke. Donald reported that this unit is between 1,300 and 1,400 feet thick, although the attitude of the beds and the width of the outcrop shown on his geologic map suggest that the maximum thickness of the unit may be as much as 6,000 feet.

Donald did not assign an age to his Lower Conglomerate, but the apparent gradation of this unit into the overlying Contreras Conglomerate Member suggests that the lower conglomerate is of the same general age as the Pitoikam Formation.

## CONTRERAS CONGLOMERATE MEMBER

The Contreras Conglomerate Member of the Pitoikam Formation forms the crest of the Baboquivari Mountains at the head of Fresnal Wash. This member is made up of pinkish-brown boulder conglomerate which is interbedded with thin beds of sandstone and siltstone. The unit forms steep slopes trenched by narrow ravines and littered with loose boulders. This conglomerate is here named for Contreras Creek because this feature is almost the only one near of outcrop whose place name is not formally or informally preempted. A type locality of the Contreras Conglomerate Member of the Pitoikam Formation is exposed along the unnamed wash that heads nearly a mile north of Peak 6164 (fig. 1).

The contact between the Contreras Conglomerate Member and the underlying conglomerate has been described on page I 7. The Contreras Conglomerate Member is distinguished from the underlying lower conglomerate because (1) its fragments are predominantly of a single volcanic rock type, in contrast to the variety of volcanic and sedimentary rock types in the lower conglomerate member, and (2) because the proportion of boulder to fine-grained beds is greater in the Contreras than in the underlying lower conglomerate member. In addition, the two units can be separated in the field by a fairly sharp color break; the lower conglomerate member is predominantly blue-gray, and the Contreras Conglomerate Member is pinkish brown.

The Contreras Conglomerate Member grades upward into the shale and arkose of the upper member of the Pitoikam, and the contact is placed arbitrarily at the base of the lowest well-defined maroon mudstone bed at the type locality. The contact may be in slightly different places along the strike. In the uppermost part of the Contreras, beds of maroon mudstone typical of the upper member become increasingly common. Above the arbitrary contact, the upper member includes beds of conglomerate similar to those in the Contreras, but these beds decrease in number upward in the section and disappear within about 300 feet of the base. Slippage along bedding planes is common in the transition zone between the middle and upper members of the Pitoikam Formation.

The Contreras Conglomerate Member is composed almost entirely of fragments of pinkish quartz latite porphyry. The fragments range from coarse sand, composed of broken mineral crystals, to boulders several feet in diameter. The pebbles and larger fragments, which are predominantly subrounded to rounded, are set in an arkosic matrix consisting of predominantly subangular pea-sized gravel and finer fragments. The Contreras is composed mostly of thick—as much as 20-foot—beds that are predominantly boulders, but it also includes

thinner beds, some only about 6 inches thick, that are mostly sandstone and mudstone. The beds are lenticular, and channel filling and fluvial crossbedding are common.

The Contreras Conglomerate Member is as much as 4,400 feet thick at its north end where it is faulted against the Ali Molina Metamorphic Complex, but southward, it either thins or grades laterally into and becomes indistinguishable from the finer grained deposits of the upper member of the Pitoikam Formation.

### CHILTEPINES MEMBER

The Chiltepines Member of the Pitoikam Formation is composed mostly of maroon and green shale containing thin beds of arkose, quartzite, and in the basal part, conglomerate. South of Fresnal Wash the Chiltepines Member includes a thin sequence of andesitic rocks. The unit weathers easily and forms a narrow valley between ridges composed of the underlying Contreras Conglomerate Member and the overlying volcanic rocks. The type locality for the Chiltepines Member is generally along the lower part of the tributary of Fresnal Wash that heads about a mile north of Peak 6164 (fig. 1); this tributary contains the type locality of the Contreras Conglomerate Member.

The Chiltepines Member is mostly maroon and green shale and greenish-gray arkose; however, may conglomerate beds are intercalated with maroon mudstone near its base. The unit also includes thin resistant beds of quartzite. The conglomerate beds near the base are composed mostly of quartz latite porphyry fragments and are indistinguishable from beds of the Contreras Conglomerate Member. Higher in the section, the conglomerate beds contain fragments from a variety of igneous rocks that include dacite and andesite; the higher conglomerate beds are reddish where the matrix is muddy and grayish green where the matrix is coarser and arkosic or tuffaceous. The gray-green arkosic beds are composed mostly of fragments of dacite. Beds in the Chiltepines Member range from a few inches to many feet in thickness; the thickest beds are of mudstone, which is either stuctureless or very thin bedded to laminar. Lateral changes in lithology are abrupt and frequent, and no single bed can be traced more than a few hundred feet.

The uppermost part of the Chiltepines Member south of Fresnal Wash is a thin series of andesite and andesitic breccia (laharic?) flows. These flows are included in the Pitoikam Formation because they are interbedded with Pitoikam-like shale beds and because they are separated from the overlying unit by an eroded surface.

## MULBERRY WASH VOLCANIC FORMATION

Latite, quartz latite, and andesite flows and interbedded conglomerate rest nearly conformably on the Pitoikam Formation. This sequence is named for Mulberry Wash, which cuts across the north end of exposures of the unit. The Mulberry Wash Volcanic Formation is 3,000 feet thick and comprises three principal units, each of which forms a rugged brown ridge. The type locality is along Fresnal Wash, although not all rock types of the formation are exposed along this drainageway (fig. 1).

The lowest unit is about 1,100 feet thick and consists mostly of alternating pink and gray quartz latite porphyry flows and some fine-grained porphyritic and site flows. The quartz latite porphyry contains plagioclase and orthoclase phenocrysts, many of which are as much as 2 mm in diameter, and conspicuous quartz "eyes" which are as much as 1 cm in diameter. The ground mass is fine grained. The only megascopic mafic mineral is magnetite. Locally, flow structure is displayed clearly.

The middle unit is about 900 feet thick and consists mostly of a pink agglomerate or conglomerate which is composed exclusively of rounded quartz latite porphyry cobbles and boulders set in a matrix of quartz latite porphyry fragments. The weathered surface is covered with boulders, and the unit is similar to the Contreras Conglomerate Member of the Pitoikam Formation. Unlike the Contreras, however, which is clearly sedimentary because it contains sedimentary structures, the middle unit of the Mulberry Wash Volcanic Formation may be of volcanic origin. Although a few fine silt beds indicate some reworking of the material by water, most of the unit is structureless, and locally the conglomeratelike beds grade into flows. The lower contact has a local relief of as much as 5 feet.

The upper unit is about 1,000 feet thick and contains mostly pink latite porphyry, red laminated felsite, and flows(?) of red and dark-gray andesite porphyry. A black vesicular basalt flow, 10–30 feet thick, is at the base, directly overlying the middle member, but in general the darker andesitic flows are dominant near the top.

The disconformity between the Mulberry Wash Volcanic and Pitoikam Formations is particularly well marked by the erosional cutoff of the aplitic, dacitic, and latitic dikes which intrude the Pitoikam and older rocks. Although the Mulberry Wash Volcanic and Pitoikam Formations are nearly conformable, the hiatus between the two units indicates that a history of uplift and erosion took place after the Pitoikam was intruded by dikes and sills.

In general, the disconformity between the two formations is masked by gouge along shearing planes and deposition of black manganese

minerals in the zone of shearing. Where mineralization is of commercial grade, the manganese has been mined. The top of the Mulberry Wash Volcanic Formation was eroded before the deposition of the Chiuli Shaik Formation.

## CHIULI SHAIK FORMATION

The Chiuli Shaik Formation forms the upper unit of the Mesozoic(?) section in the Baboquivari Mountains and is named for the nearby village of Chiuli Shaik. The Chiuli Shaik Formation comprises beds of discontinuous lenticular intertonguing sedimentary and volcanic rocks, which lie disconformably on an eroded surface of as much as 300 feet of relief cut into the Mulberry Wash Volcanic Formation. The Chiuli Shaik in turn is overlain unconformably by the Fresnal Conglomerate, of local usage (Fair, 1961), of probable Tertiary age. Some of the beds crop out boldly and form steep, rugged hills; others erode to valleys, swales, or a generally hummocky terrain.

The Chiuli Shaik consists of two apparently conformable units. The lower unit is predominantly sedimentary, and the upper unit is almost entirely volcanic. The Chiuli Shaik Formation is about 2,000 feet thick.

The lower unit of the Chiuli Shaik is made up of red to brown conglomerate, grayish-brown mudflows, gray-green pebbly and sandy arkosic and graywacke beds and a few local lenses of blue-gray limestone. Numerous thin flows of red or gray laminated felsite and a few lenticular andesitic breccia and flow units are intercalated with the sedimentary strata. The fragments within the conglomerate beds are composed largely of andesite from the upper unit and of quartz latite porphyry and other rocks of the two lower units of the Mulberry Wash Volcanic Formation. The lower unit of the Chiuli Shaik is about 750 feet thick.

The upper unit of the Chiuli Shaik is itself made up of two parts. The lower sequence comprises flows and breccias of maroon and purplish andesite and of porphyritic andesite, and the upper sequence comprises beds of rhyolite tuff and rhyolite welded tuff. In a few places, thin sedimentary lenses are intercalated with the volcanic units. The upper unit of the Chiuli Shaik is about 1,000 feet thick.

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