U.S. DEPARTMENT OF THE INTERIOR

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Geologic map of the Formaster Well quadrangle, northern Mohave County, Arizona

by
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INTRODUCTION

The Formaster Well 7.5′ quadrangle (96 sq km) is located in northern Mohave County, Arizona, about 13 km south of the Arizona/Utah State line and Colorado City, Arizona, the nearest settlement, northwestern Arizona (fig. 1). Altitudes range from about 1,460 m (4,790 ft) at the southwest corner of the quadrangle to 1,590 m (5,220 ft) near the southeast corner of the quadrangle. Access to the quadrangle is by improved dirt road, locally referred to as the Clayhole Wash road, from Colorado City, Arizona. Several unimproved dirt roads lead from the Clayhole Wash road to various locations within the quadrangle area. Travel on these roads can be done with 2 wheel drive vehicles except on unimproved trails because of muddy, or sandy conditions.

The entire area is managed by the U.S. Bureau of Land Management, including about two sections that belong to the state of Arizona. About one section of private land is found along the northeastern edge of the quadrangle. The area supports sparse growths of sagebrush, cactus, and various grasses. Tamerisk trees (Salt Ceder) are restricted to stock tank and diversion dam areas near Clayhole Wash.

PREVIOUS WORK

The first geologic map of this quadrangle was a photogeologic map made by C.H. Marshall (1956a) for the U.S. Atomic Energy Commission of what was then called the Lost Spring Mountain SE quadrangle. Marshall′s map was compiled onto two Arizona state geologic maps, one at a scale of 1:500,000 (Wilson and others, 1969) and the other at a scale of 1:1,000,000 (Reynolds, 1988). Geologic quadrangle maps border this quadrangle on the northeast by Marshall and Pillmore (1956), on the east by Marshall (1956b), on the southeast by Marshall (1956c), on the north by Billingsley (1993a), and on the northwest by Billingsley (1993b).

MAPPING METHODS

A preliminary geologic map was made from 1:24,000-scale aerial photographs. In particular, many of the Quaternary alluvial units having similar lithologies were mapped using photogeologic methods. Detailed field investigations were then conducted to check photo interpretations and to obtain descriptions for all map units.

GEOLOGIC SETTING

The map area lies within the Uinkaret Plateau, a subplateau of the southwestern part of the Colorado Plateaus physiographic province (fig. 1). This part of the Uinkaret Plateau is characterized by relatively flat lying and gently folded Triassic sedimentary rocks that have an average regional dip of about 2° northeast.

A few northwest-trending normal faults offset Triassic strata in the southwest and southeast parts of the quadrangle. If there are other faults within the quadrangle, they are covered by extensive alluvial deposits. Thickness of the Triassic strata is based on exposures about 8 km north of this quadrangle where the entire Lower, Middle(?), and part of the Upper(?) Triassic sequence is well exposed at Lost Spring Mountain (Billingsley, 1993a, b).

Cenozoic deposits of fluvial pediment and alluvial fans cover much of the map area. The distribution of these Quaternary deposits are an important factor to consider in future environmental, land, and range management planning in this area by federal, state, and private organizations. The

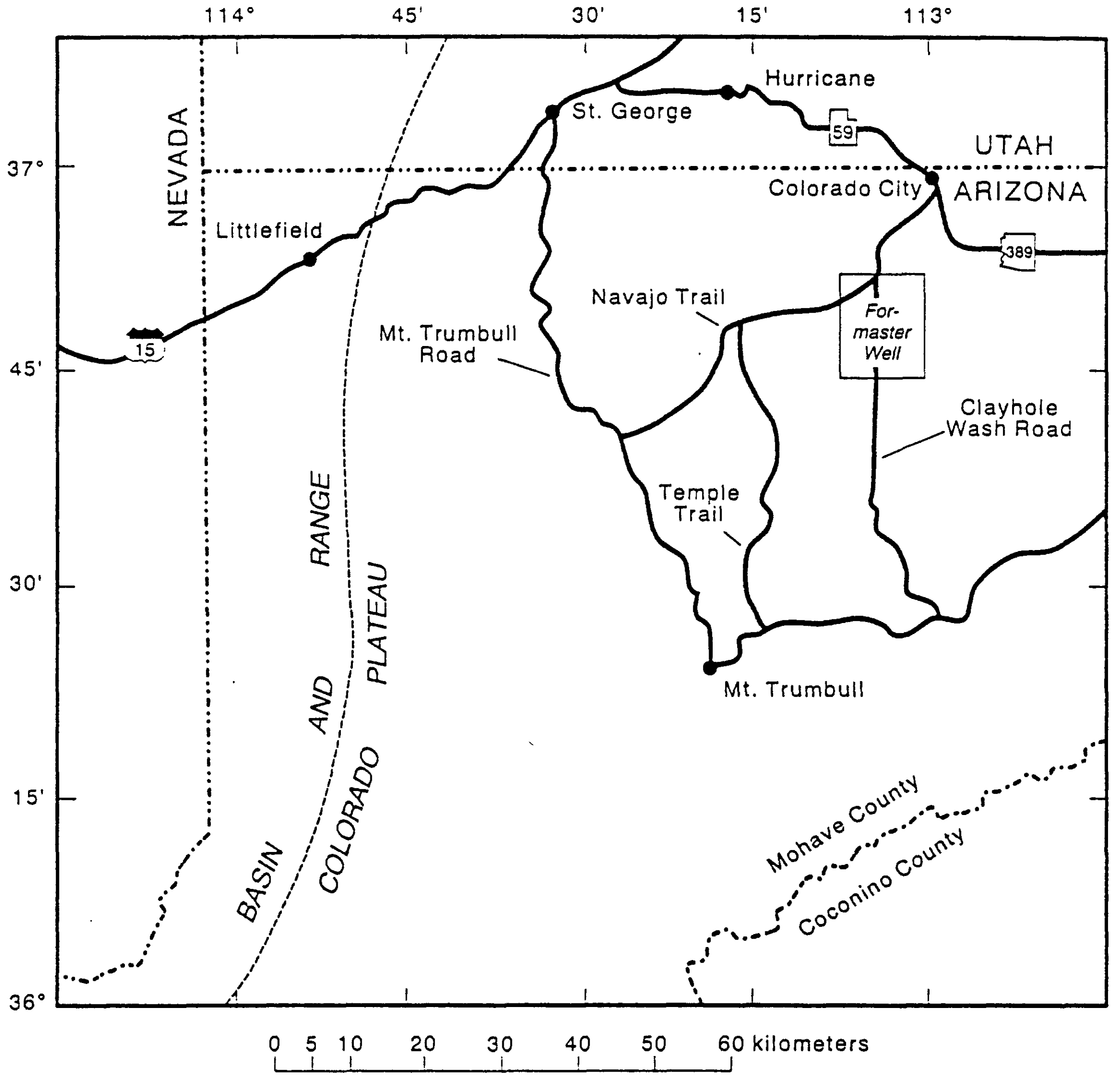

Figure 1. Index map of northern Mohave County, northwestern Arizona, showing the Formaster Well, AZ 7.5′ quadrangle.

surficial units are useful in the study of local geomorphology and have intertonguing and gradational contacts.

STRATIGRAPHY

The oldest rocks are sedimentary and are members of the Moenkopi Formation (Middle(?) and Lower Triassic), and the lowest member of the Chinle Formation (Upper(?) Triassic). The Shinarump Conglomerate Member of the Chinle Formation crops out along the southeast edge of the quadrangle. The tan-brown resistant conglomeratic sandstone beds of the Shinarump are separated from the red beds of the Moenkopi Formation by an erosional unconformity. Scattered boulders of the Shinarump have been left in pediment deposits on a ridge above the Shnabkaib Member of the Moenkopi Formation, east-central edge of quadrangle.

Outcrops of igneous rocks are basaltic dikes and associated erosional remnants of Pleistocene basalt flows. At Black Knoll, north-central part of the quadrangle, a basalt dike and flow was extruded as a dike along a northwest trending joint system. Another basalt dike and minor flow is 6.5 km south of Black Knoll aligned in a similar northwest strike and are assumed to be of similar age. The K-Ar whole rock age for the basalt at Black Knoll is 0.58±0.30 Ka (Harold Mehnert, U.S. Geological Survey Isotope Laboratories, Denver Co., written commun., 1993). The igneous outcrops have shed fragments onto the surrounding pediment deposits indicating that the pediment surfaces have eroded only slightly in the last 580 thousand years. The distribution of basaltic fragments do not extend into the pediment deposits more than 500 m from the basaltic sources.

Pale red, gray, and brown alluvial pediment and other alluvial deposits cover more than three-quarters of the quadrangle surface area. The pediment surface is partly covered by a thin lag gravel made up of multicolored, well-rounded chert and quartz pebbles derived from the Shinarump forming a desert pavement. This thin desert pavement distinguishes the pediment deposits from younger alluvial deposits in the quadrangle area.

The Quaternary age assigned to the alluvial deposits in the quadrangle is based mainly on field relationships of these deposits with similar deposits west and north of this quadrangle and their relation to Pleistocene and Pliocene basalt flows (Billingsley, 1992a, b; 1993a, d, e). Details of the stratigraphic sequence of alluvial deposits are given in the description of map units.

STRUCTURAL GEOLOGY

Most of the normal faults offset strata down to the southwest. Geologic mapping just west of the quadrangle (Billingsley, 1993a, 1994, in press), indicates that faulting was partly late Pliocene, mostly Pleistocene and Holocene in age.

Several gently folded anticlines and synclines have a north to northwest axial trend in the central and southwest parts of the quadrangle. An overall regional exposure of strata indicate an east to northeast regional dip.

DESCRIPTION OF MAP UNITS

Surficial deposits

Qaf **Artificial fill and quarry pits (Holocene)**--Alluvial and bedrock material removed from pits and trenches to build stock tanks and drainage diversion dams for flood control

Qs **Stream-channel alluvium (Holocene)**--Unconsolidated and poorly sorted, interlensing silt, sand, and pebbles. Intertongues or inset to alluvial fan (Qa_1), terrace-gravel (Qg_1 and Qg_2), and upper part of pediment (Qp) deposits. Stream channels subject to high-energy flows and flash floods and support little or no vegetation. Contacts approximate. Estimated thickness 1 to 2 m

Qf **Flood-plain deposit (Holocene)**--Chiefly gray silt and fine-grained sand and clay; locally cemented by clay, gypsum, and calcite. Subject to frequent temporary ponding. Sparse or no vegetation. Estimated thickness 2 to 3 m

Qg_1 **Young terrace-gravel deposit (Holocene)**--Unconsolidated, light-brown to pale-red siltstone, sandstone, and lenses of gravel containing pebbles of well rounded black, red, yellow, gray, and white quartzite. Locally contains minor amounts of petrified wood fragments. Includes reworked materials from alluvial fan (Qa_1), pediment (Qp), and higher terrace-gravel (Qg_2) deposits. Forms terrace bench about 0.5 to 1.5 m above local stream beds. Sustains moderate growth of salt cedar trees. Averages about 1.5 m thick

Qa_1 **Young alluvial fan deposit (Holocene)**--Unconsolidated silt and sand. Includes lenses of coarse gravel composed of multicolored, rounded pebbles of chert and quartzite and few cobbles of light red sandstone. Partly cemented by calcite and clay. Intertongues with stream-channel alluvium (Qs), upper part of valley-fill (Qv), and terrace-gravel (Qg_1 and Qg_2) deposits. Alluvial fan subject to erosion by sheet wash and flash floods. Supports sparse vegetation composed of cactus, and grass. As much as 2 m thick

Qv **Valley-fill deposit (Holocene and Pleistocene)**--Partly consolidated silt, sand, and lenses of pebble to cobble gravel. Contains red, yellow, and black, well-rounded pebbles, sand and silt, reworked from pediment (Qp) deposits; partly cemented by calcite and gypsum. Intertongues with low terrace-gravel (Qg_1), and alluvial fan (Qa_1) deposits. Valleys subject to sheetwash flooding and temporary ponding; cut by arroyos in some larger valleys. Supports thick vegetation composed of sagebrush, grass, and cactus. As much as 4 m thick

Qg_2 **Higher terrace-gravel deposit (Holocene and Pleistocene)**--Similar to young terrace-gravel (Qg_1) deposits. Consists mainly of light-red and gray, fine-grained sand, silt, and clay; partly cemented by calcite and gypsum. Intertongues with young alluvial fan (Qa_1) deposits. Forms flat benches about 3 to 5 m above local stream beds. Sustains sparse growth of sagebrush and grass. Averages about 5 m thick

Qg_3 **Older terrace-gravel deposit (Holocene and Pleistocene)**--brown and gray silt, sand, gravel, and small pebbles and cobbles. Contains subrounded to rounded basalt, chert, limestone, sandstone, and multicolored quartzite and quartz pebbles. Multicolored pebbles are derived from Shinarump Member of Chinle Formation and average 6 mm in diameter. Basalt clasts are derived from Pleistocene volcanoes just south of quadrangle area. Forms terrace near Clayhole Wash, southwest corner of quadrangle. About 3 to m thick

Qp **Pediment deposit (Holocene(?) and Pleistocene)**--Pale red, tan, and brown, fine-grained sandstone, siltstone and multicolored, well-rounded to rounded quartz and quartzite pebbles derived from the Shinarump Member of the Chinle Formation; partly cemented with calcite, gypsum, and clay. Pebbles form minor desert pavement as lag gravel composed of black, brown, gray, white, red, and yellow, well-rounded pebbles averaging less than 2.5 cm in diameter; includes rare, rounded, petrified wood fragments derived from erosion of Shinarump Member of Chinle Formation. Includes integrated, poorly defined sand sheet deposits (not mapped). All material locally derived from Triassic sedimentary strata. Intertongues with alluvial fan (Qa_1), and valley-fill (Qv) deposits. Approximately 1 to 3 m thick

Qi **Intrusive dike (Pleistocene)**--Dark-gray, finely crystalline, aphanitic groundmass. Forms Black Knolls and another unnamed ridge 6.5 km south of Black Knolls surrounded by pediment deposits. Both outcrops are aligned north 45° west along joint and fracture system

Qb **Basalt flow (pleistocene)**--Dark-gray, finely crystalline, aphanitic groundmass. Flows are associated with dikes (Qi) and have flowed less than 150 m from dike source. K-Ar whole rock age, 0.58±0.30 Ka (Harold Mehnert, U.S. Geological Survey Isotope Laboratories, Denver Co., written commun., 1993). Less than 2 m thick

Sedimentary Rocks

Chinle Formation (Upper Triassic)--Includes Shinarump Member as used by Stewart and others (1972)

ŦRcs **Shinarump Member**--Orange-brown, black, and tan, coarse-grained, cross-bedded to flat-bedded, conglomeratic sandstone. Weathers brown and black. Includes stream-channel deposits largely composed of well-rounded, black, brown, red, gray, white, and yellow quartzite pebbles and gravel; about 30% of clasts are black. Contains silicified logs and wood fragments. Fills erosion channels cut into upper red member of Moenkopi Formation estimated as much as 2 m deep. Forms ledges. Top part eroded, as much as 6 m thick

Moenkopi Formation (Middle? and Lower Triassic)--Includes, in descending order, upper red member, Shnabkaib Member, middle red member, Virgin Limestone Member, and lower red member as used by Stewart and others (1972). The Middle-Lower Triassic boundary probably lies in the upper red member (Morales, 1987)

ŦRmu **Upper red member**--Heterogeneous sequence of red sandstone, siltstone, mudstone, conglomerate, and minor gray gypsum. Includes ledges of thin-bedded sandstone in upper and lower part. Gradational contact with underlying Shnabkaib Member at base of lowest red sandstone. Basal contact placed arbitrarily near top of highest thick white siltstone and dolomite bed of Shnabkaib. Forms slope. About 50 m thick

ŦRms **Shnabkaib Member**--Interbedded, white, laminated, aphanitic dolomite and silty gypsum. Includes light-red, thin-bedded mudstone, siltstone, and sandstone in upper and lower part based on exposures north of this quadrangle (Billingsley, 1993a). Contact with middle red member not exposed in this quadrangle. Forms slope with ledges. About 20 m thick

ŦRmm **Middle red member**--Red-brown, thin-bedded, laminated siltstone and sandstone, red, white, and gray gypsum, minor white platy gypsiferous dolomite, green siltstone, and gray-green gypsiferous mudstone. Gradational contact with Virgin Limestone Member placed at top of highest gray limestone bed of Virgin Limestone. Forms slope. About 45 to 50 m thick

ŦRmv **Virgin Limestone Member**--Consists of three light-gray, thin-bedded to thinly laminated, ledge-forming limestone beds, 0.5 to 2 m thick, separated by white, pale-yellow, red, and gray slope-forming, thin-bedded, gypsiferous siltstone. Uppermost limestone bed locally missing. Includes thin beds of brown, red, and green siltstone, gray limestone, and brown platy, gypsiferous calcarenite between limestone beds. Includes star-shaped crinoids and poorly preserved brachiopods in top part of lowest limestone bed; fossil algae in second highest limestone bed. Erosional unconformity at base of lowest gray limestone truncates underlying red siltstone of lower red member as much as 3 m deep. Forms small ledges in slope. As much as 20 m thick

ŦRml **Lower red member**--Red, thin-bedded, sandy siltstone; gray, white, and pale-yellow laminated gypsum and minor sandstone. Includes laterally discontinuous, coarse-grained, thin-bedded, calcareous sandstone bed in lower part. Base not exposed in this quadrangle. As much as 37 m thick

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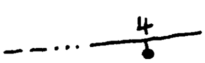
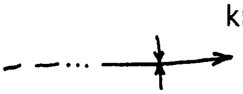
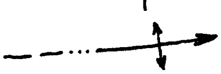
Contact--Dashed where approximately located



Fault--Dashed where approximately located or inferred; dotted where concealed; bar and ball on downthrown side. Number is estimated displacement in meters.

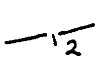
Folds--Showing trace of axial plane and direction of plunge where known; dashed were approximately located; dotted where concealed


Syncline


Anticline

Strike and dip of beds

Inclined



Approximate--Estimated photogeologically

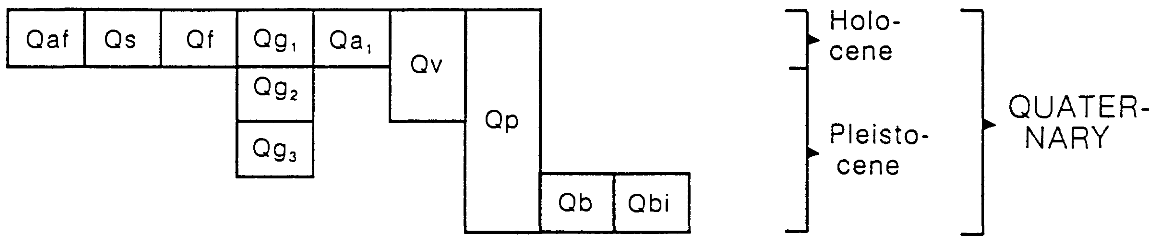
Implied--Determined photogeologically, amount of dip undetermined

Strike of vertical and near-vertical joints--Determined photogeologically

Sinkhole--Enclosed depression

CORRELATION OF MAP UNITS

SURFICIAL DEPOSITS AND IGNEOUS ROCKS



SEDIMENTARY ROCKS