U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Geologic map of the Sullivan Draw South quadrangle, northern Mohave County, Arizona

by
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Open-File Report 91-559

1991

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INTRODUCTION

Sullivan Draw South quadrangle (96 sq km) is located in northern Mohave County Arizona, about 64 kilometers south of the Utah-Arizona state line (fig. 1). Elevations range from about 4,960 ft at Hobble Canyon to about 5,965 ft in the southwest corner of quadrangle. The nearest settlement is St. George, Utah, about 72 kilometers north of the quadrangle. Access to the quadrangle is by dirt road locally referred to as the Mt. Trumbull road south from St. George, Utah to Wolf Hole, Arizona, an abandoned ranch. A unimproved dirt road leads south from Wolf Hole about 16 kilometers to the quadrangle area (fig. 1).

The area is managed entirely by the U.S. Bureau of Land Management. The area is sparsely vegetated with sagebrush, cactus, pinion pine and juniper trees.

PREVIOUS WORK

There are no previous small-scale geologic maps of this area. The area is included in two Arizona state geologic maps, on at a scale of 1:500,000 (Wilson and others, 1969), and the other at 1:1,000,000 (Reynolds, 1988). Geologic maps in preparation of bordering areas include, on the west, the St. George Canyon 7.5 quadrangle, Arizona, and to the north, the Sullivan Draw North 7.5 quadrangle Arizona.

GEOLOGIC SETTING

The quadrangle lies in the northern part of the Shivwits Plateau, a sub-physiographic plateau of the southwestern Colorado Plateau Geologic Province. The quadrangle is characterized by flat-lying Paleozoic strata with a regional dip of about 2° east. The strata are cut by a few small grabens and normal faults that have a general north-south strike. Small sinkhole depressions pockmark the landscape. Cenozoic deposits are widely distributed and characterized as geomorphic surficial alluvial or mass-moved erosional deposits based on landform development and their relationship to underlying structures and erosional changes. The surficial units often merge or intertongue and share an arbitrary map boundary.

STRATIGRAPHY

About 85.3 m of Kaibab Formation (Lower Permian) are exposed and form the surface rock for most the quadrangle area. Minor outcrops of the lower Moenkopi Formation cropout in narrow, Permian-Triassic paleovalleys (fig. 2). The surface bedrock of this quadrangle is gray, cherty or sandy limestone of the Kaibab and gray or red conglomerate and siltstone, and gray to white siltstone and gypsum of the Moenkopi. Stream-deposited and minor mass-moved deposits cover some of the bedrock. Details of the stratigraphy are given in the description of map units.

STRUCTURAL GEOLOGY

Sullivan graben, northeast quarter of the quadrangle, averages about 0.8 kilometers wide at Little Joe Draw to nearly 1.6 kilometers wide at Sullivan Draw. The graben has a north strike. Other structural features include minor north-trending grabens, normal faults, and circular collapse features. The graben structures are indicative of late Tertiary east-west extensional stresses. Numerous local small sags and folds associated with solution of gypsum in the Kaibab Formation, especially in drainages, are too small and irregular to show at map scale.

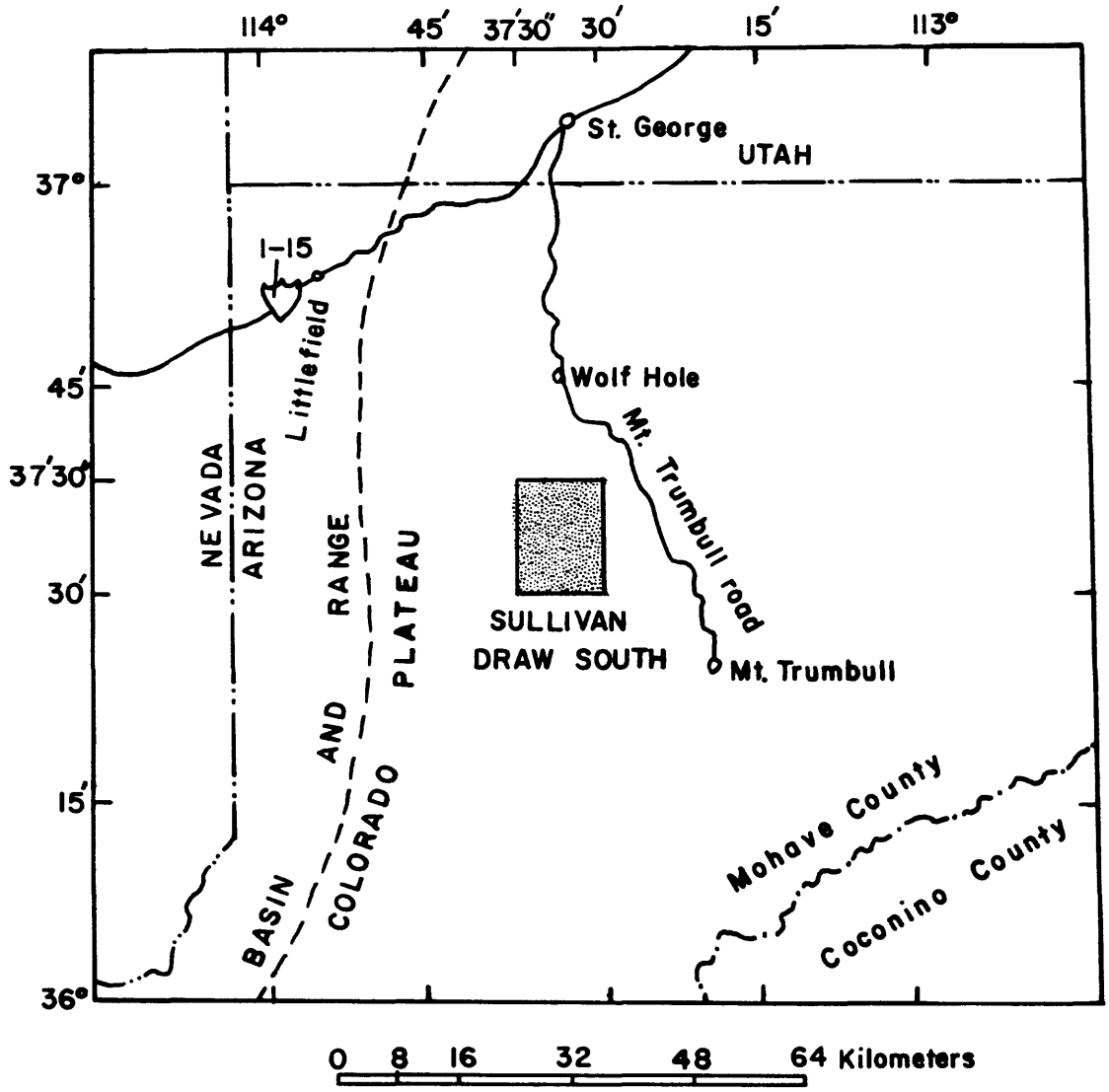

Figure 1. Sullivan Draw South 7.5 quadrangle, northern Mohave County, northwestern Arizona, showing mapped area in this report.

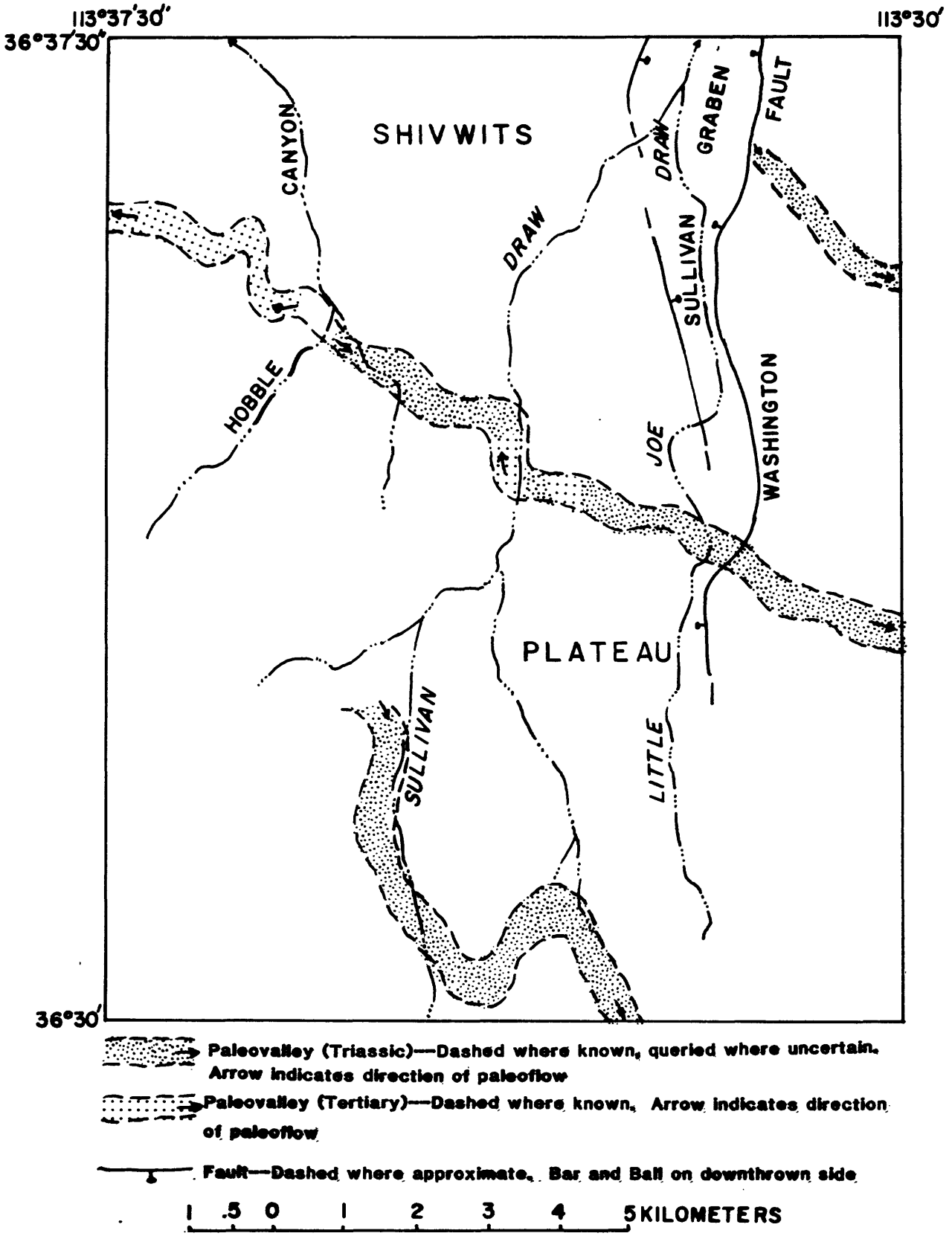

Figure 2. Selected geographic and geologic features of the Sullivan Draw South 7.5 quadrangle, northwestern Arizona.

Collapse Structures

Circular collapse structures, and other surface irregularities are due to solution of gypsum and gypsiferous siltstone. However, some circular, bowl-shaped areas that have inward-dipping strata, may be collapse-formed breccia pipes originating in the deeply buried Mississippian Redwall Limestone (Wenrich and Huntoon, 1989). Such features on this quadrangle, commonly with inward-pointing dip symbols, are marked by a dot and the letter "C" to denote possible deep-seated breccia pipes. They cannot with certainty be distinguished by surface forms from shallow collapse structures caused by removal of gypsum. Moreover, some deep-seated breccia pipes are known to be overlain by gypsum collapse features (Wenrich and others, 1986). The deep-seated breccia pipes are potential host for economic deposits of copper and uranium; the shallow structures are unlikely to be mineralized (Wenrich, 1985).

Shallow sinkholes and karst caves are associated with the solution of gypsum in the Harrisburg Member of the Kaibab Formation. The sinkholes are denoted with the letter "S" and a triangle symbol when the feature forms an enclosed depression or cave on the land surface. Many local drainages originate at open sinkhole depressions and are not shown on this quadrangle. The sinkholes are young features, Holocene and probably as old as Pleistocene.

DESCRIPTION OF MAP UNITS

Surficial Deposits

Qf **Floodplain deposits (Holocene)**--Unconsolidated, light-gray or brown silt and sand with lenses of pebble to cobble gravel. Intertongues and merges with valley-fill (Qv), talus (Qt), terrace (Qg_1), and alluvial fan (Qa1) deposits. Partly consolidated with gypsum and calcite cement. Thickly vegetated by sagebrush and cactus. Subject to periodic flooding and local temporary ponding. Thickness about 1 to 18 m

Qg_1 **Low terrace-gravel deposits (Holocene)**--Unconsolidated, light-brown, pebble to boulder gravel composed about equally of well-rounded limestone to angular and subrounded chert clasts. Includes lenses of silt and sand. Commonly merges with alluvial fan (Qa_1), and valley-fill (Qv) deposits. Forms a bench about 1-4.5 m above floodplains. Thickness up to about 1 to 10 m

Qa_1 **Alluvial fan deposits (Holocene)**--Unconsolidated silt and sand; contains lenses of coarse gravel composed of subangular to rounded pebbles and cobbles of limestone, chert, and some sandstone; partly cemented by gypsum and calcite. Merges with valley-fill (Qv), floodplain (Qf), and low terrace-gravel (Qg_1) deposits. Subject to erosion by flash floods and sheet wash. Sparse to moderate vegetation of pinion pine, juniper trees, sagebrush and cactus. Thickness as much as 10 m

Qv **Valley-fill deposits (Holocene and Pleistocene?)**--Partly consolidated silt, sand, and interbedded lenses of pebble to small cobble gravel. Consists of local talus (Qt), alluvial fan (Qa_1), in small drainage valleys. Some deposits spread out as alluvial fans (Qa_1) and merge with floodplain (Qf) or other valley-fill (Qv) deposits at some drainage junctions. Subject to sheetwash and ponding; cut by arroyos in larger valleys. Thickly vegetated by sagebrush, grass, and cactus. Thickness as much as 11 m

Qg_2 **High terrace-gravel deposits (Holocene and Pleistocene?)**--Similar to low terrace-gravel deposits (Qg_1), partly consolidated; on benches about 3 to 12 m above main alluvial valleys. Merges with some valley-fill (Qv) and alluvial fan (Qa_1) deposits. Locally overlain and underlain by alluvial talus (Qt) shed from nearby bedrock surfaces. Thickness about 1.5 to 4.5 m

Qt **Talus deposits (Holocene and Pleistocene)**--Unsorted debris consisting of brecciated gravel and blocks up to 3 m diameter. Includes some sand and silt, partly cemented by calcite and gypsum. Merges with valley-fill (Qv) and alluvial fan (Qa_1) deposits. Sparse vegetation of sagebrush, grass, and cactus. Thickness as much as 8 m

Qa_2 **Older alluvial fan deposits (Holocene and Pleistocene)**--Similar to young alluvial fan (Qa_1); partly cemented by calcite and gypsum. Partly buried by young alluvial fans but not shown because of indifferent boundaries. Deposits partly dissected by erosion and reworked into lower young alluvial fans (Qa_1). Moderately vegetated by sagebrush, cactus, and grass. Thickness about 1.5 to 10 m

Ta **Older alluvium (Pliocene)**--Primarily light-brown silt, sand, and gravel with some pebbles and cobbles. Clasts consists of white chert and dark-gray limestone derived locally from the Kaibab Formation and sparse, well-rounded, basalt and quartzite pebbles up to 4 cm in diameter. The basalt source is likely from Poverty Mountain vicinity (K-Ar date of 4.75±0.26 Ma.; Best and others, 1980) about 11 kilometers southeast of map area. Quartzite and petrified wood clasts are rare indicating probable re-working of bedrock material from lower part of Chinle Formation that crops out further south. Deposits occupy paleovalleys re-entrenched into Permian-Triassic paleovalleys eroded into Kaibab Formation containing soft rocks of Moenkopi Formation (fig. 2). Thickness about 1.5 to 15 m

Sedimentary Rocks

Moenkopi formation (Middle? and Lower Triassic)--Includes, in descending order, lower red and Timpoweap members as defined by Stewart and others (1972)

TR ml **Lower red member**--Red and gray, thin-bedded, sandy siltstone interbedded with gray, white, and pale-yellow, laminated, gypsifereous siltstone and minor sandstone. Confined to collapse features and paleovalleys eroded into underlying Kaibab Formation. Forms slope. Thickness about 3 to 12 m

TR mt **Timpoweap Member**--Gray limestone and white chert conglomerate interbedded with gray, coarse-grained, chert/limestone gravel matrix; cemented with calcite and gypsum. Clasts up to 15 cm in diameter are derived from Harrisburg Member of Kaibab Formation. Fills paleovalleys eroded into underlying Kaibab Formation about 49 m deep and 305 to 488 m wide (fig. 2). Conglomerate lenses are interbedded with lower red siltstone in east-central part of map (TR mlt). Forms rounded ledges. Pebble imbrication indicates north flow of depositing stream in Sullivan Draw area and east flow near Little Joe Draw. Thickness 3 to 25 m

TR mlt **Lower red and Timpoweap Members undivided**--Same lithologies as T ml and T mt above. Clasts consists of gray limestone and white, well-rounded chert derived from the Kaibab Formation up to 6 cm in diameter. Forms slope. Thickness about 1 to 15 m

Kaibab Formation (Lower Permian)--Includes, in descending order, Harrisburg and Fossil Mountain Members as defined by Sorauf and Billingsley (1991)

Pkh **Harrisburg Member**--Consists of light-gray, sandy, fine- to medium-grained limestone interbedded with red and gray gypsiferous siltstone, sandstone, and gray gypsum beds several meters thick. Includes gray, thin-bedded, cherty limestone and sandy limestone which form resistant cliff near top of unit. Cherty limestone and sandy limestone beds form surface rock in northeast two-thirds of quadrangle. Undetermined amount of upper sediments are eroded away. Solution of interbedded gypsum has locally distorted bedding. Forms slope with limestone ledges at top. Thickness as much as 70 m

Pkf **Fossil Mountain Member**--Yellow-gray to gray, fine- to medium-grained, thin-bedded, fossiliferous, sandy, cherty, limestone. Chert weathers black. Gradational with overlying Harrisburg; arbitrary map contact between cherty limestone and siltstone slope. Forms resistant bench below siltstone slope. Only top part exposed this quadrangle. Thickness about 30 m

Contact--Dashed where approximately located

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

Strike and dip of strata

Inclined

Approximate--Estimated photogeologically

Implied--Determined photogeologically, no estimate of amount determined

Strike and dip of vertical joints

Collapse structure--Circular collapse, strata dipping inward toward central point. May reflect deep-seated breccia pipe collapse originating in Redwall Limestone

Sinkholes--Steep-walled or enclosed depression or cave

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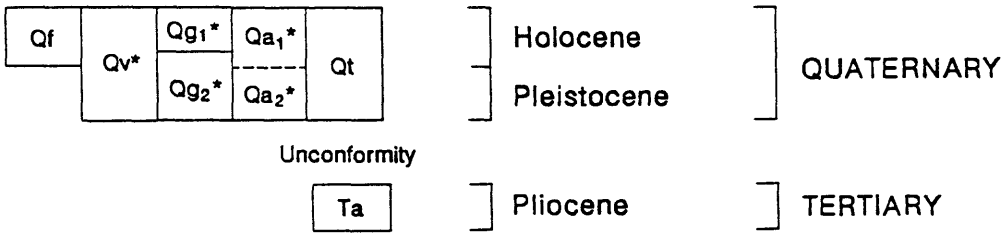
CORRELATION OF MAP UNITS

SURFICIAL AND VOLCANIC DEPOSITS

* See description of map units for exact unit age assignment



SEDIMENTARY ROCKS