UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

PRELIMINARY GEOLOGIC MAP OF THE OLAF KNOLLS QUADRANGLE, MOHAVE COUNTY, ARIZONA

By

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This report is preliminary and has not been edited or reviewed for conformity with U.S. Geological Survey standards and nomenclature.

GEOLOGIC SETTING

This map is part of a regional study of the Grand Wash Fault. Geologic mapping was carried out by Lucchitta in 1973, and by Lucchitta and Beard in 1981.

The Grand Wash fault forms the boundary between the Colorado Plateau and the Basin and Range Province to the west. The fault is a high-angle normal fault that trends approximately north and is down to the west. Along most of its trace, the fault is buried by the Tertiary Muddy Creek Formation and other upper Cenozoic deposits. In this quadrangle, however, the fault is composed of a complex system of subparallel breaks, many of which are excellently exposed along the Grand Wash Cliffs. Typically, these breaks are of small displacement and up to the west. Where the fault system is widest and best developed, the up-to-the-west faults are associated with westerly tilts of 15-30° in the Paleozoic beds. The faulting and tilting combine to maintain structural elevation as one goes west. Substantial net down-to-the-west displacement is attained only at the main breaks. The first of these is composed of en-echeleon segments located at or near the base of the Grand Wash Cliffs, and typically drops the uppermost Paleozoic units (Kaibab, Toroweap and Hermit Formations, and possibly part of the Esplanade Sandstone) against Mississippian rocsk. One or more additional breaks are located west of the Grand Wash Cliffs and are buried by basin fill and other upper Cenozoic deposits. Most of the displacement that formed the basin occurred along these buried faults.

The map area is in a region where stratigraphic units change and thicken rapidly westward form the platform sequence of the Grand Canyon to the shelf sequence of the eastern Great Basin. The changes in stratigraphy, which are matched by changes in nomenclature, are not yet studied adequately. To avoid potential conflicts and to facilitate structural mapping, which is the main purpose of this study, we have simplified parts of the stratigraphic column into map units with distinctive lithologic and outcrop characteristics.

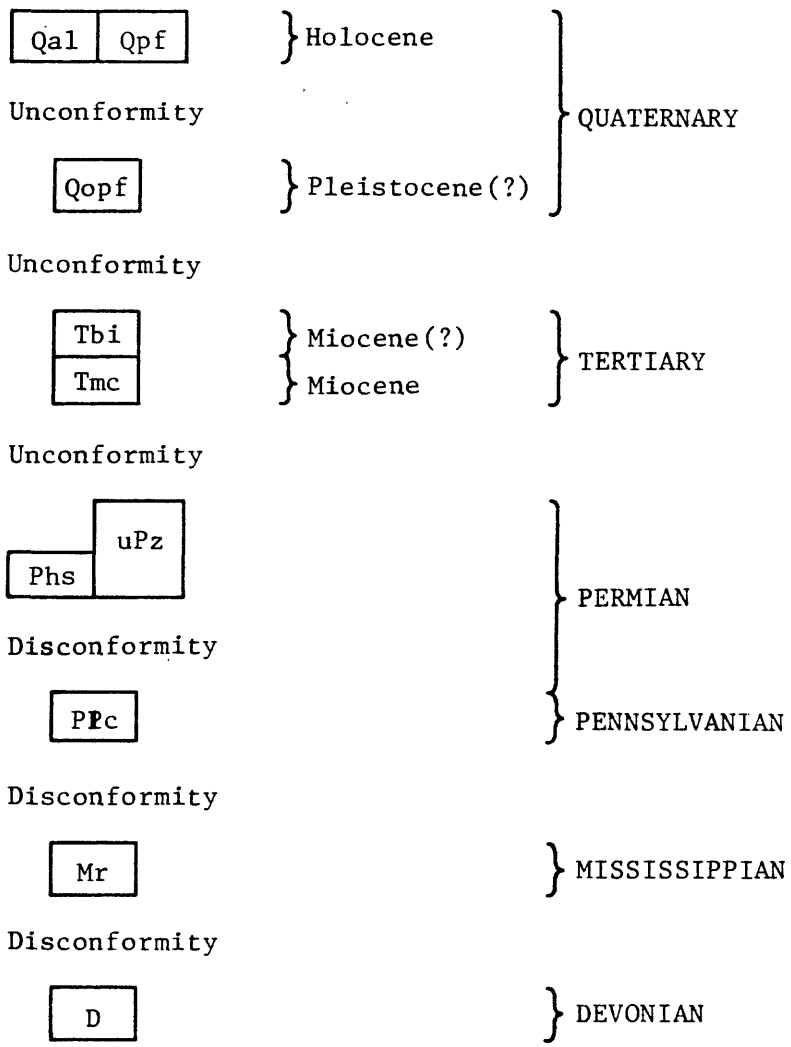
In the classic Grand Canyon section, a thick sequence of redbeds occupies the interval between the Redwall Limestone and the Coconino Sandstone. The redbeds are subdivided into the Supai Group of McKee (1975) and the overlying Hermit Shale. Both are composed of hematitic sandstone, siltstone and shale in various proportions. To the west, the Supai Group becomes increasingly calcareous. At the Grand Wash Cliffs, in rocks equivalent to the Supai Group of McKee, 1975 are composed of well bedded limestone with interbedded reddish cross-bedded sandstone and red shale. Only the upper part of the uppermost unit of the Supai, the Esplanade Sandstone remains carbonate-free. McNair (1951) referred to the underlying calcareous units as the Pennsylvanian Callville Limestone and the Permian Pakoon Limestone. Although disconformities separate many of these units, the main break in lithology and weathering characteristics occurs between the cliff-forming limestones and the overlying slope-forming redbeds of the upper Esplanade and Hermit. We therefore have mapped the former at the Permian and Pennsylvanian Pakoon and Callville Limestones undivided and the latter as the Permian Hermit and Esplanade Formations undivided. The Callville as mapped thus includes rocks equivalent to all the Supai Group of the Grand Canyon except the upper part of the Esplanade Sandstone. A more extensive discussion of the nomenclature and correlations of these rocks is given by G. H. Billingsley (1978).

The Devonian as mapped includes the interval between the unclassified dolomites of McKee and Resser (1945), also called undifferentiated dolomites by Billingsley (1978), and the Redwall Limestone. These rocks are equivalent to the Middle Devonian Temple Butte Formation of the Grand Canyon and the Muddy Peak Formation of the Lake Mead area.

The Muddy Creek Formation is a term applied by Longwell (1936) and Lucchitta (1966) to Miocene interior-basin deposits filling the Grand Wash Trough, even though these rocks are not physically continuous with beds in the type locality (Muddy Valley of Nevada) which were called "Muddy Creek beds" by Stock (1921).

Several inactive copper prospects and mines occur within the quadrangle. In the surface workings, mineralization occurs in cross bedded sandstone beds of the Callville Limestone (sensu latu). Structural control of mineralization appears likely. The presence of basaltic dikes in the vicinity also suggests the possibility of hydrothermal mineralization.

CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

[Areas marked with queried unit symbols have not been field checked]

Qal ALLUVIUM (HOLOCENE)--Silt, sand, gravel, cobbles and boulders in active washes. Consists of angular to subangular, poorly sorted, unconsolidated material of local derivation. Thickness unknown; probably less than 2 m. Grade into, and locally includes pediment gravels

PIEDMONT-SLOPE DEPOSITS (HOLOCENE AND PLEISTOCENE)

Qpf Pediment and fan gravels (Holocene)--Silt, sand, gravel, cobbles and boulders on active pediments and fans. Consists of angular, poorly sorted, unconsolidated material of local derivation. Thickness unknown; probably less than a few meters. Pediment and fan gravels grade laterally into each others. Both grade laterally into, and locally include recent alluvium

Qopf Older pediment and fan gravels (Pleistocene?)--Silt, sand, gravel, cobbles and boulders on gently sloping surfaces that are at various elevations above modern washes, by which they are being dissected. Consists of angular, poorly sorted, unconsolidated material of local derivation. Thickness generally less than 10 m. Pediment and fan gravels grade laterally into each other

Tbi BASALTIC DIKES (MIOCENE)--Porphyritic basaltic dikes, less than 1 m wide. Typically very altered and weathered. The matrix is relatively fresh in a few samples, and is finely crystalline with visible plagioclase and iddingsitized olivine groundmass crystals. The phenocrysts are altered, comprise 5-30 percent of the total rocks, range in size from less than 1 mm to 5 mm, and are composed of iddingsitized olivine, clinopyroxene(?), and probable plagioclase

Tmc MUDDY CREEK FORMATION (MIOCENE)--Claystone, siltstone, sandstone, pebble to boulder fanglomerate, freshwater limestone, dolomite and gypsum, deposited under conditions of interior drainage in the Grand Wash basin, which was formed by basin-range faulting. The various facies grade into each other both laterally and vertically. In quadrangle, unit consists chiefly of well- to poorly bedded, moderately consolidated sandstone and fanglomerate containing subangular to subrounded pebbles to boulders of Paleozoic rocks derived from the east. The fanglomerate locally fills steep and narrow canyons and cuts into the Grand Wash Cliffs. Unit is at least 600 m, and probably several thousand meters thick

uPz (PERMIAN) ROCKS, UNDIVIDED--Includes all or part of the Kaibab Limestone, Toroweap Formation, Coconino Sandstone, Hermit Shale, and Esplanade Sandstone. Present as intricately broken downfaulted wedges

Phs HERMIT SHALE AND UPPER PART OF ESPLANADE SANDSTONE OF SUPAI GROUP UNDIVIDED (PERMIAN)--Redbed sequence that includes the Hermit Shale and that part of the Esplanade Sandstone of White (1922) that overlies the highest carbonate beds. The Hermit comprises moderately to poorly indurated deep-red siltstone and light-red thin-bedded sandstone. Upper part of the Esplanade includes moderately indurated, brick-red to white, fine-grained, cross stratified, cliff-forming sandstone as well as poorly indurated deep-red gypsiferous shale

PPc PAKOON LIMESTONE OF MCNAIR, 1951 (PERMIAN) AND CALLVILLE LIMESTONE (PENNSYLVANIAN) UNDIFFERENTIATED--Predominantly light-gray, fossiliferous, locally cherty, well-bedded limestone that forms ledges and ledgy slopes, with interbeds of purplish-red cliff-forming cross bedded sandstone and red slope-forming shale. Thickness about 300 m

Mr REDWALL LIMESTONE (MISSISSIPPIAN)--Light-gray, aphanitic to crystalline, fossiliferous, mostly thick bedded limestone, cherty in lower part. Forms massive, conspicuous cliff. Thickness 180-200 m

D DEVONIAN ROCKS--Medium- to dark-gray, medium-grained, medium- to thick-bedded, typically fetid dolomite, limestone, and dolomitic sandstone. Upper part forms alternating ledge and slope; lower part forms color banded cliff. Thickness 140-200 m

REFERENCES

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EXPLANATION OF MAP SYMBOLS

———— CONTACT--Dashed where approximate

FAULT--Showing dip, direction and plunge of slickensides, or rake of slickensides. Bar and ball on downthrown side. Dashed where approximately located or probable, queried where doubtful, dotted where concealed.

STRIKE AND DIP OF BEDS

Inclined

⊕ Horizontal

MARKER BED