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## *Some geologic features of the St. Michaels area, Arizona*

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*This is one of many related papers that were included in the 1958 NMGS Fall Field Conference Guidebook.*

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## SOME GEOLOGIC FEATURES OF THE ST. MICHAELS AREA, ARIZONA

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### INTRODUCTION

The St. Michaels area, site of the University of Arizona geology field camp, is located 25 miles northwest of Gallup, New Mexico, in northeastern Arizona. Sedimentary rocks are most abundant but igneous and metamorphic rocks are also present. Structural features are easily studied. The area covered in this paper is located on the east flank of the Defiance uplift and is bounded on the north by Fort Defiance, on the south by Hunters Point, on the east, approximately, by the Arizona-New Mexico State line, and on the west by the crest of the Defiance structure. Black Creek flows south through the central portion of the area and its valley is flanked on both sides by excellent bedrock exposures.

### STRATIGRAPHY

Precambrian(?) rocks comprise the core of the Defiance uplift and are exposed at two places within the area mapped. A granitic mass crops out in the first canyon south of Hunters Point and farther south in the next major canyon, slates, phyllites, and metavolcanics are present. The exposures of these units are poor and generally the rocks occur in isolated, unrelated outcrops.

The Permian Supai formation unconformably overlies the Precambrian rocks. It crops out near Hunters Point in the southwestern part of the area. The rocks of this unit are predominantly shale, siltstone, and sandstone of reddish color; they generally form a steep slope. The contact with the Precambrian rocks is well marked by the occurrence of a basal conglomerate which contains pebbles of the underlying basement rocks.

The Permian DeChelly sandstone overlies the Supai and outcrops of it occur all along the western portion of the area. The DeChelly is an aeolian sand with large sweeping crossbeds. The upper part may be locally whitish in contrast to its typical red-brown color. The contact with the underlying Supai is somewhat arbitrarily drawn between the base of the main cliff and the top of the slope.

The Triassic Moenkopi formation is generally not present in the area. Locally, however, exposures of rocks considered to be Moenkopi crop out along the cliff edge at Hunters Point. These rocks are mainly red colored sandstone and shale.

The Triassic Chinle formation, in most areas, caps the DeChelly sandstone. Rocks of this unit have a large areal extent. They occur in the broad central part of Black Creek valley and along most of its western margin. The Chinle is of extremely varied lithology; very distinctive units in the area are a sparkling white to tan sandstone with local conglomeratic lenses forming the Shinarump member at the bottom of the formation, a massive, white to tan, resistant sandstone in the middle part, and a lime pellet conglomerate or a calcareous chertstone which occurs near the top of the formation. Most of the Chinle, however, is made up of easily eroded red, purple, brown, and gray colored shale with some siltstone and conglomerate. Fragments and logs of petrified wood are locally abundant. The upper contact of the Shinarump member is drawn at the base of a brown conglomeratic sandstone and the lower contact at an erosion surface separating it from the DeChelly.

Overlying the Chinle are rocks of the Wingate sandstone of Triassic age. The color is normally variegated orange and red with a change in color commonly following the bedding. Short crossbeds predominate. Sandstone is the main rock type but, locally shale occurs exhibiting the same variegated colors. The rocks of this unit are exposed in the area at the base of the first hogback on the east side of Black Creek valley.

Rocks of the Jurassic Entrada sandstone crop out along the eastern edge of Black Creek valley where they form the lower slope of the first hogback. The color of the rocks is reddish-tan near the base and it grades upward into a lighter tan near the top of the formation. Large scale crossbedding is characteristic. The contact with the Wingate sandstone is drawn where the sandstones assume the clean appearance typical of the Entrada.

Capping the Entrada are rocks of the Jurassic Cow Springs sandstone which form the upper part of the first hogback. They are tan to reddish-tan in color and have large scale crossbeds similar to those of the Entrada. Lithologically, rocks of the Cow Springs are similar to those of the Entrada and locally they are hard to distinguish. In outcrop the Entrada tends to form smooth rounded "haystacks" whereas the Cow Springs tends to be a little more rugged and bold in its exposures. In some areas the contact is readily marked by the "Todilto notch" but in other areas a contact can only be inferred.

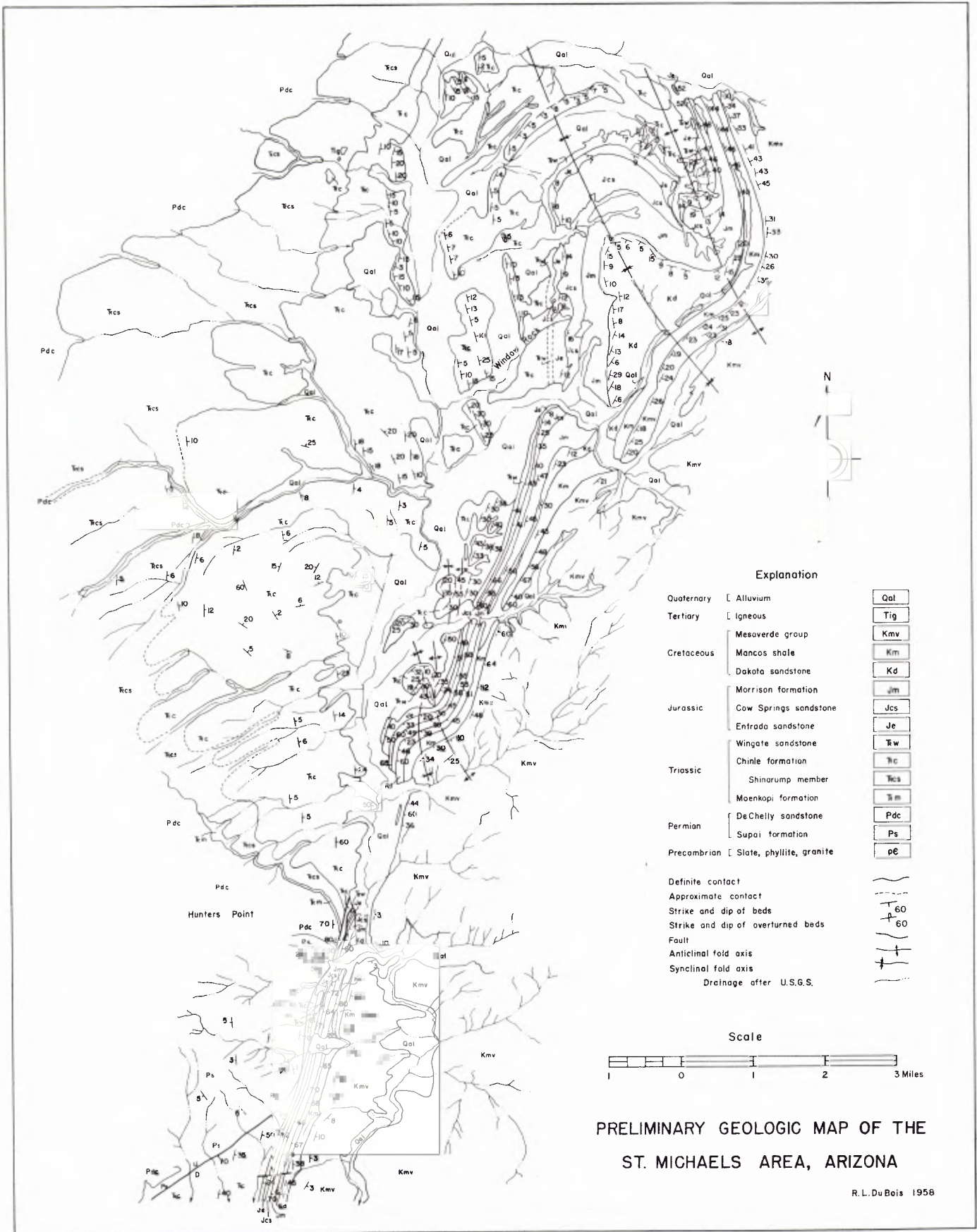
The colorful Morrison formation of Jurassic age overlies the Cow Spring sandstone. This unit crops out in the area between the first and second hogbacks and occupies the valley. It extends up the slope of the second hogback to within some 20 feet of the top. The rocks of this unit vary from sandstone, which locally forms steep cliffs, to shale which occurs as a slope former. The color ranges from white through red and tan to purple. The lower contact with the Cow Springs is generally not exposed and it is drawn at the base of the stripped structural surface forming the back of the Cow Springs-capped first hogback.

The Dakota sandstone of Cretaceous age caps the second hogback. The rocks are mainly sandstones but locally shales and coal beds are noted. The sandstones are mostly tan in color. The contact with the underlying Morrison is usually marked by the presence of a basal conglomerate.

Between the second and third hogbacks is a valley eroded into units of the Cretaceous Mancos shale. Outcrops of this formation are scarce. When observed the rocks are generally gray shale and frequently very fossiliferous. The contact with the Dakota is generally not exposed and it is drawn at the base of the Dakota stripped structural surface.

The third and last hogback on the east is capped by rocks of the lower units of the Cretaceous Mesaverde group. A resistant tan formation; the Gallup sandstone, forms the crest of the hogback. Farther east the units of this group are shales, coal beds, and sandstones.

Several igneous bodies of vogesitic composition are intrusive into the area. By analogy with the Hopi volcanics, these Navajo intrusives are assumed to be of Tertiary age. These rocks crop out in an arcuate body in the north-central part of the area and as a small dike-like



unit west of the main mass.

Bedded Quaternary alluvium is common in Black Creek valley. Silt and sand are the most abundant but locally conglomeratic lenses are present. Recent downcutting has dissected the alluvium down to bedrock or to the point where earlier downcutting had progressed prior to the deposition of the alluvium.

#### STRUCTURE

The most prominent structural feature of the area is the flexure zone that occurs between the flat lying beds of the Mesaverde group on the east and those of the DeChelly occurring on the west. Classically this structure has been termed a monocline but its cross-section deviates from the normal pattern. At Hunters Point the DeChelly and Shinarump beds are folded down steeply to the east with local overturning of as much as ten degrees. To the west of this area the DeChelly is essentially flat lying as are the beds of the Mesaverde group to the east. North of this area the beds pass from flat-lying ones on the west to gentle east-dipping beds along the western side of Black Creek valley. In Black Creek valley the Chinle beds mostly dip to the east but in many areas there are small

anticlines and synclines. Along the eastern margin of the valley the beds all have steep easterly dips until farther east the beds of the Mesaverde are flat lying.

The overall trend of the structure is northerly but it is very sinuous with small scale disruptions occurring to the north of Hunters Point and larger ones farther north. These modifying structures are anticlines and synclines with the anticlines located near the main hogbacks. Their axial trends are roughly northwesterly and their plunge is to the southeast. It is interesting that these modifying features seem to increase in size northward from Hunters Point.

Associated with the sharp flexure at Hunters Point is a high angle fault which is traceable for several miles to the south. It has a northerly trend near Hunters Point but to the south swings to a northeasterly trending normal fault with displacements exceeding 600 feet. This structural feature brings the Chinle and overlying beds in close proximity to the Supai rocks. Especially noticeable is the foreshortening of the thick Chinle sequence; several parallel faults are localized in this incompetent unit bringing lower and upper units close to each other.

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