The writer believes that answers to the above and similar questions must come through topical studies as well as detailed field mapping and stratigraphic correlation. Of particular interest would be (1) studies of the distribution of heavy minerals in the fine sediments and their possible source areas, (2) detailed mapping of characteristic rock types found in the sediments for provenance study, (3) geochemical dating and correlation of volcanic rocks throughout the area, (4) geophysical studies of the configuration of the basement complex in the alluvial basins, (5) studies of the clay-mineral components of the fine sediments for information on the nature of weathering of their source, and (6) morphological studies of the mountain fronts themselves for possible differences in erosion rates.

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GEOLOGY OF THE EASTERN PART OF THE SAFFORD BASIN, GRAHAM COUNTY, ARIZONA

(A Preliminary Report)

By

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INTRODUCTION

A comprehensive geohydrologic study of the Safford basin is being made by the Ground Water Branch of the U. S. Geological Survey in cooperation with the University of Arizona. Work undertaken by the Survey includes geologic mapping of the various sedimentary and geomorphic units occurring in the basin. To date, the eastern end of the basin has been mapped. The most significant results of this work are outlined below.

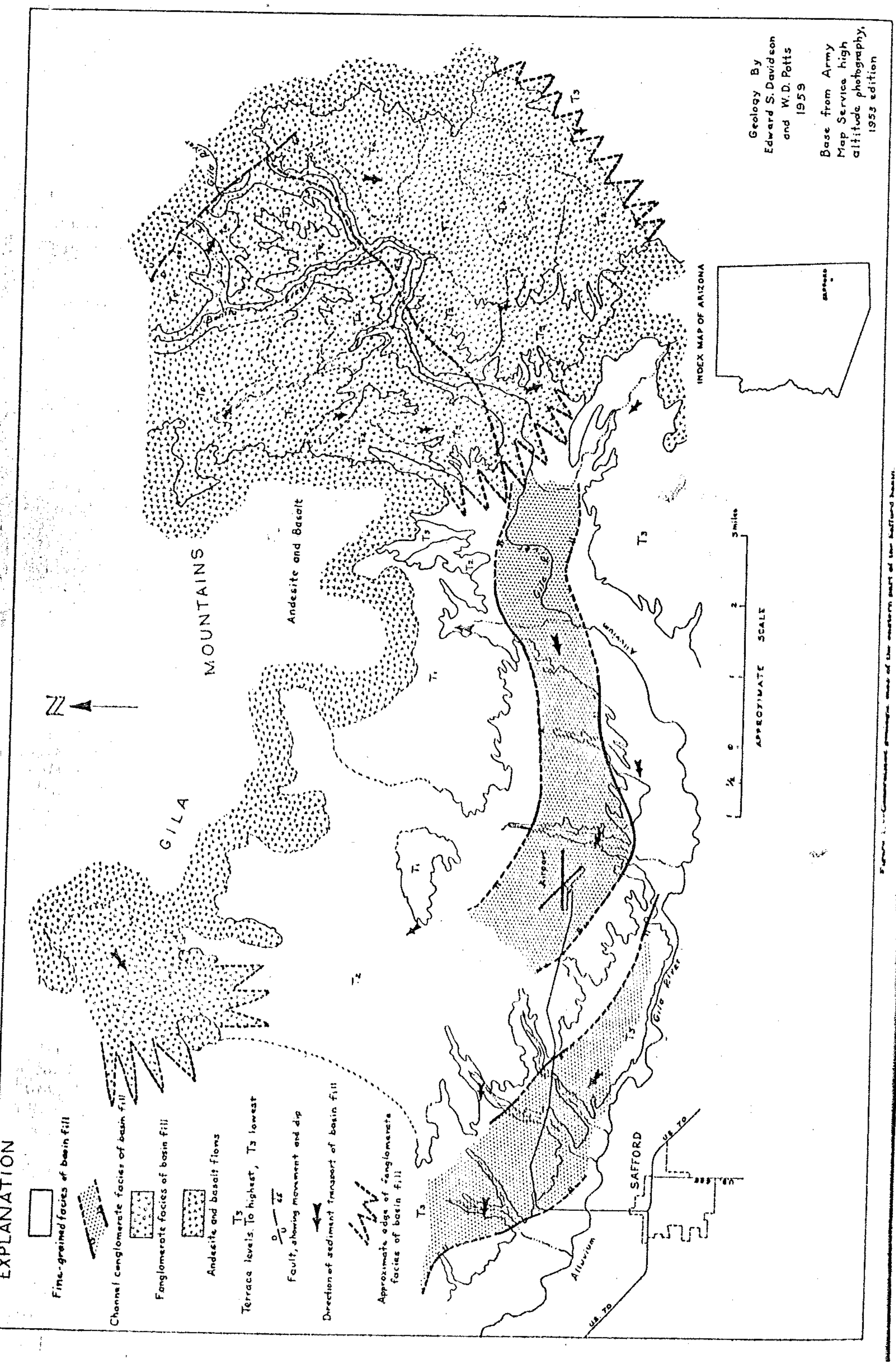
Several sedimentary geologic units occur in the basin: The stratigraphically lowest sediment is the basin fill; overlying the basin fill are gravels which cap the terraces that extend in steps from the Gila River to the mountain edges; and alluvium beneath the present flood plain of the Gila River. The alluvium is the youngest sediment within the map area. The generalized distribution of 1) several facies of basin fill, 2) terraces, and 3) alluvium is shown on figure 1.

BASIN FILL

The rocks of the basin fill in the map area comprise three sedimentary facies. These are fanglomerate, sand and silt, and shoestring deposits of conglomerate enclosed at several stratigraphic levels in the sand and silt. At least two fanglomerates crop out at the mouth of Bonita Creek and a third fanglomerate occurs in the northwestern part of the map area. The two fanglomerates exposed at the mouth of Bonita Creek total more than 1,000 feet in thickness (L. A. Heindl, 1958, Cenozoic alluvial deposits of the upper Gila River area, New Mexico and Arizona: Arizona Univ., Tucson, unpublished doctoral thesis). The other two principal facies of the basin fill extend out from the area of fanglomerate outcrop at the mouth of Bonita Creek.

The older fanglomerate at the mouth of Bonita Creek is indurated and composed of boulders and cobbles of basalt, andesite, and rhyolite set in a carbonate-cemented sandstone matrix having the same composition. Andesite and basalt flows are intercalated near the base of the older fanglomerate along the Gila River and Bonita Creek. Some of these lava flows are contiguous along their strike with widespread tuff beds up to 100 feet in thickness. The fanglomerate is crossbedded and imbricated, and the trend of these structures indicates that the source area lies to the northwest. Several normal faults having up to 80 feet of displacement occur in this fanglomerate, but they do not displace rocks of the overlying fanglomerate. The older fanglomerate is in fault contact with andesite and basalt flows cropping out in the extreme northeast corner of the map area (Heindl, op. cit., p. 64).

The younger fanglomerate unconformably overlies the older fanglomerate. It is moderately friable and contains boulders of andesite, basalt, rhyolite, quartzite, and red granite. This fanglomerate crops out mainly on the east side of the Gila River in the fanglomerate area, and intertongues with both of the finer grained basin-fill sediments seen in the Safford basin proper (W. L. Van Horn, 1957, Late Cenozoic beds in the upper Safford Valley, Graham County, Arizona: Arizona Univ., Tucson, unpublished master's thesis). Crossbeds, imbricate structures, and composition indicate that the source of this fanglomerate lies to the north.



The small fanglomerate in the northwestern part of the map area is at the mouth of a fairly large drainage area. The volume of sediment contributed to the Safford basin from this fanglomerate area is not large in comparison to the amount contributed from the northeastern end of the basin.

The sand and silt beds apparently can be divided into two stratigraphic units. The lower unit grades from brown crossbedded sand having conglomerate interbeds, west of the airport (fig. 1), to light-brown silt and green silt and mudstone southwest of the airport. The upper unit consists of brown sand and silt and numerous pebble-conglomerate beds. This unit is interbedded with the northern shoestring channel conglomerate described below. It crops out only in the map area east of the airport. The grain size of the sediments in this unit grades from medium and coarse near the channel conglomerate to very fine near the Gila Mountains. The sand and silt consist of grains of quartz, mica, and feldspar; the conglomerate beds contain pebbles of basalt, andesite, rhyolite, and red granite.

The shoestring conglomerate beds, up to 1-1/2 miles in width and about 50 feet in thickness, trend westward in the central part of the basin. They have the same composition as the younger fanglomerate. Bedding structures and composition indicate that the conglomerates were deposited by a stream that flowed from the fanglomerate area. Two channel deposits are shown in figure 1; the northern deposit is stratigraphically about 50 feet higher than the southern, and interfingers laterally with buff-colored sand and silt. The central and western exposures of this deposit show about 10 to 15 feet of scouring into underlying beds. The southern deposit lies with erosional unconformity on the lowermost sand and silt unit. This conglomerate may be equivalent in age and stratigraphic assignment to the northern shoestring conglomerate, or it may be equivalent to the much later terrace gravels in level T3 (fig. 1). More fieldwork may clarify this problem.

The pattern of sedimentation in the eastern part of the Safford basin suggests that the exposed basin fill was deposited largely by an ancestral river entering the basin from the northeast. However, the exposed sediments represent only a small part of the sediments in the basin. It is not yet known whether these same conditions can be postulated for the entire thickness of fill in the Safford basin. The large areas of mud and fine-grained sediments encountered by drill holes indicate that lake and swamp deposits may be widespread in the unexposed part of the section. The presumption is that a considerable part of these sediments was derived from the surrounding mountain blocks. Therefore, any extrapolation of the surface geology to depth should be done with caution.

The hydrologic implications gained from the sediment distribution are of importance, especially if the distribution of sediments at depth is similar to that seen in the exposed outcrops. The classical view holds that the basin sediments are derived from the adjacent mountains and are coarse near the mountain edges, grading outward to fine-grained sizes in the central part of the basin. The sediments near the mountain edges, being coarser, would be highly permeable and maximum recharge to the basin reservoir could be expected along the mountain fronts. In the eastern part of the Safford basin, at least in part, the finer sediments lie against the rock shelves of the basin, and coarser, more permeable sediments extend out only from places where ancient major tributaries entered the basin. The areas of possible large and significant natural recharge to the basin sediments along the mountain fronts may be limited to the relatively small areas of fanglomerate outcrop near the mouths of ancient tributaries (Lance, 1959), and to those places in the central part of the basin where the channel conglomerates and coarser sand occur and are in contact with similar deposits which are possible avenues of recharge.

TERRACE GRAVELS

Terrace gravels overlie the basin fill with erosional and angular unconformity. The several terrace levels (fig. 1) are separated by vertical intervals of 40 to 100 feet. The gravel deposits are composed of cobbles of andesite, basalt, rhyolite, and red granite, and range from 10 to 40 feet in thickness. Some of this material is derived locally, but much of it has a more distant, upstream source. These terraces may represent ancient base levels of the Gila River and its tributaries in the Safford basin. It follows that the bed of the ancient Gila River was hundreds of feet above its present elevation. As pointed out above, the southern mapped channel deposit may correlate with terrace gravels in level T3 (fig. 1), and therefore may represent an ancient bed of the Gila River.

ALLUVIUM

The large areas of alluvium are confined to the present flood plain of the Gila River. The sediments are poorly consolidated mixtures of sand, gravel, and silt. This material probably is up to 150 feet in thickness in the Gila River valley and is the main source of ground water in the Safford area at this time.

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LATE CENOZOIC GEOLOGY OF THE LOWER SAFFORD VALLEY--A PRELIMINARY REPORT

By

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INTRODUCTION

The lower Safford Valley, as here defined, includes the intermontane trough drained by the Gila River from Fort Thomas, about 20 miles northwest of Safford, to Coolidge Dam where the Gila River leaves the basin through a gorge carved into the Mescal Mountains. It also includes the lower reach of the San Carlos River between its confluence with the Gila and the town of San Carlos. Late Cenozoic terrestrial sediments occur in the lower Safford trough to an unknown depth, and form a relatively soft valley fill which is cut by a well-defined pediment surface. Subsequent downcutting has resulted in an intricately dissected badland topography over most of the area. In the vicinity of the San Carlos Reservoir, lava flows are interbedded with the basin sediments and a number of small basaltic plugs have intruded the basin fill.

It is emphasized that the data presented herein are largely drawn from field inferences and are as yet unsupported by laboratory or office work.

SEDIMENTATION

The valley fill is composed of fine-grained sand, silt, clay, and limestone, lying nearly horizontally or with a gentle primary dip toward the valley axis. Previous workers (Schwennesen, 1919, Knechtel, 1937) described these beds as lacustrine in origin but differed in their interpretations of the relationship of coarse gravels on the valley margin to the fine-grained sediments in the center of the valley. Both writers correlated all or part of the beds with the Gila conglomerate of Gilbert (1875). Van Horn 1957) concluded that the beds of the upper Safford Valley are lake deposits.

The sediments are generally reddish-brown, fine sand to clay sized, well bedded and discontinuous laterally. Irregular lens-shaped units indicate deposition in intermittent, isolated bodies of water. Cross-stratification is rare and gently inclined. Calcium carbonate content in the valley fill is locally extremely variable but generally increases downstream. Thin plates of marl in the vicinity of Fort Thomas give way to hard limestone interbedded with silt at San Carlos Reservoir. Evaporites are common in the clay beds.

On the north side of San Carlos Reservoir extensive vulcanism has influenced sedimentation. Beds in this area are whitish and contrast sharply with the reddish-brown beds of the rest of the valley. Total thickness of this "white" facies is approximately 1000 feet. Tuff beds occur sporadically throughout the section, increasing in frequency upward and culminating in thick sequences of coarse pyroclastics and lava flows. Those in the lower part of the section are well stratified and probably waterlaid; in the uppermost beds, around The Triplets, impact structures 4-6 feet deep indicate a moist condition of the sediments at the time of eruption. Although some sand occurs, sediments north of the reservoir are predominantly limestone and limey silt and clay. A lateral transition into the "red" facies occurs about ten miles east of the San Carlos.

A number of green carbonaceous clay zones and a bituminous limestone attest to the intermittent existence of paludal environments of deposition. Fossil plant stems are common in situ in the "white" facies, and detrital remains of reed-like stems are abundant. Diatoms collected near Fort Thomas are described as typical of a warm, saline lake environment (Knechtel, 1937, p. 200).

The coarse gravels along the flanks are believed to be partly continuous and